

CromemcoTM
299B DISK DRIVE
TECHNICAL MANUAL

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FUNCTION OF MICROPROCESSOR IN 299 B

The microprocessor implementation on 299 B performs three major functions. These are servo control, ready status, and erase delay timing. The processor continuously executes a sequence of routines which track the status of ready and serve functions, and test the condition of the select lines to determine whether to output such status. Because seeking and writing are mutually exclusive functions. The processor also has time to calculate erase timing.

Servo Control

When the positioner is holding on track, the processor is out of the servo loop, allowing " FINE POSITION SENSE " to keep the positioner in place. When seeking to a track, the processor outputs a velocity value which directly controls the positioner while counting step and detent pulses. The processor also determines when to switch itself into and out of the feed back loop. To ensure minimum response time to changes in servo status, both STEP pulses and DETENT pulses are tied to the INTERRUPT input of the processor. Thus, whenever a stimulus is received, the processor stops whatever it was doing at the time, identifies the source of the interrupt, and treats it appropriately. The velocity for the servo is dependent upon the distance remaining to travel, and a value for each half-track of remaining distance up to 64 tracks is stored in a look-up table in memory. For greater than 64 tracks the maximum velocity is output. The DIRECTION line is sampled at the start of a seek and stored for the duration of that seek. It is output to the DtoA converter as the most significant bit or sign bit. By injecting a current equal to one half the full scale output through R103 and R104 into the D-A converter output, a uni-polar device can be used to provide signed dual polarity output.

Upon reaching a difference of zero between steps and detents, the servo is switched to the HOLD mode for final settling to track. The processor cleans up registers and track counters, and samples TKCENT (track center) and TK00 (track zero), storing them for future output conditional on selected status.

The processor also controls the RESTORE function. RESTORE may be initiated by the host via the RESTORE input, or will occur if an illegal seek is commanded (too many step pulses) or if a detent is received while holding on track.

The built-in exerciser on the 299 B automatically write-protects the drive by holding SEEK COMPLETE false in the exerciser mode.

Ready Status

The processor watches the four index lines for changes. A complete low-high-low sequence being detected on either diskette starts a timer for that diskette. The count is tested frequently, and should 200mS elapse before another index pulse is sensed, the diskette is logged not ready. In 299 B it is stored internally and output only for the selected diskette. Two-sided index is sampled when " EITHER INDEX " is high and stored for output to the host.

Erase Delay Timing

The use of tunnel-erase heads mandates a delay changes in WRITE GATE and ERASE GATE. The processor allows a refinement of this delay by adjusting it according to the track location. The INTERRUPT circuit is configured such that either edge of WRITE GATE (turn-on or turn-off) causes an interrupt. When this interrupt is identified, WRITE GATE STATUS is tested and the appropriate delay is generated; longer delays for turn-off and varying lengths dependent upon the track location. Denser formats than were available with fixes delays can be obtained.

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SECTION 1

INSTALLATION

This section contains procedures to verify the operational integrity of the diskette drive prior to on-line operation.

INSTALLATION CHECK LIST

The installation check list, Table 1-1, is designed for trained personnel to use as a guide in performing installation checks necessary for proper operation. If more detailed installation information is desired, refer to the appropriate paragraph in this section.

TABLE 1-1. INSTALLATION CHECK LIST

Visual Inspection
<ul style="list-style-type: none">a. Remove all packing material.b. Check packing list.c. Check for shipping damage.d. Remove carriage restraint inserted in Side 1.
Mechanical Checks
<ul style="list-style-type: none">a. Check that carriage assembly moves freely over entire stroke.
Cables
<ul style="list-style-type: none">a. Fabricate DC and signal cables.b. Check pin to pin resistance (all cables).c. Check pin to conductor continuity (all cables).d. Check for proper pin alignments (all cables).
Mounting
<ul style="list-style-type: none">a. Install diskette drive.b. Connect cables to diskette drive.
Checkout
<ul style="list-style-type: none">a. Operational checkout with exerciser (optional).b. Operational checkout with system.

Visual Inspection

The diskette drive is packaged to ensure adequate protection for shipping and handling (See Figure 1-1).

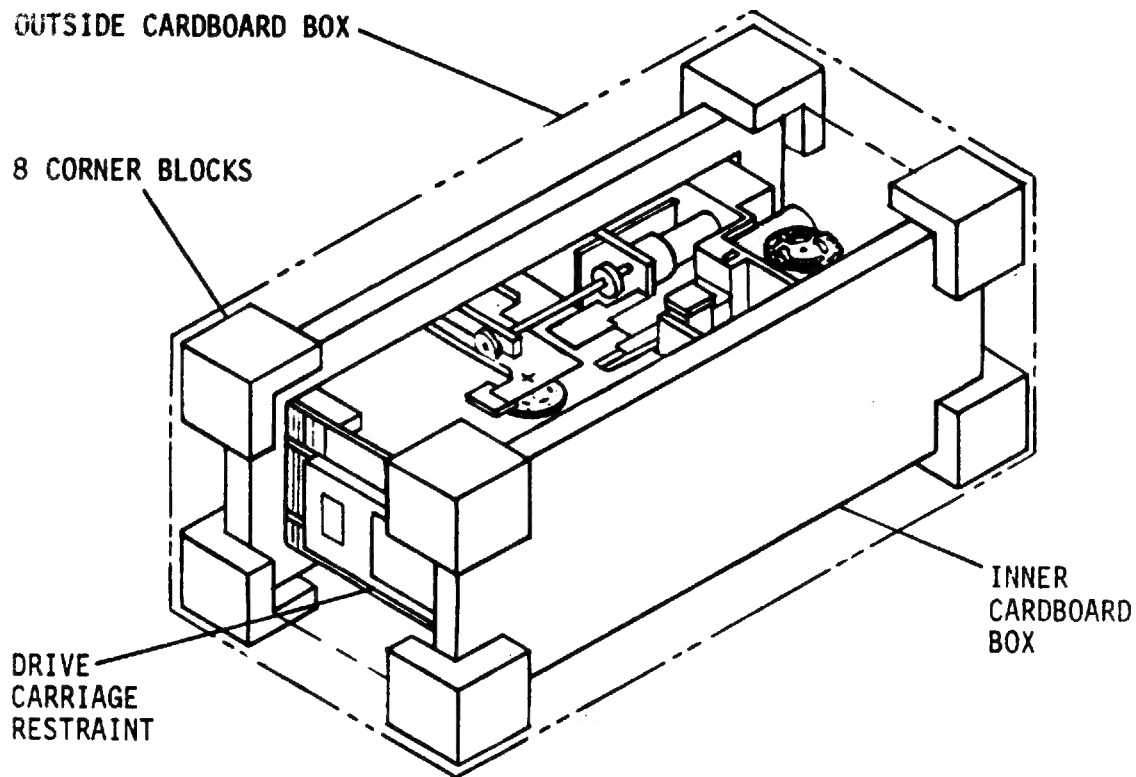


Figure 1-1. Diskette Drive Shipping Configuration

Inspect the shipping container for evidence of any in-transit damage.
If damage is evident:

- a. Contact the carrier.
- b. Contact the manufacturer.

Unpacking

After performing a preliminary inspection, unpack the diskette drive as follows:

- a. Remove all material from shipping container. Remove inner packing material.
- b. Check material received against packing list. If packing shortage, contact manufacturer.
- c. Visually inspect all items received for physical damage. If damage is evident:

Contact the carrier.

Contact the manufacturer.

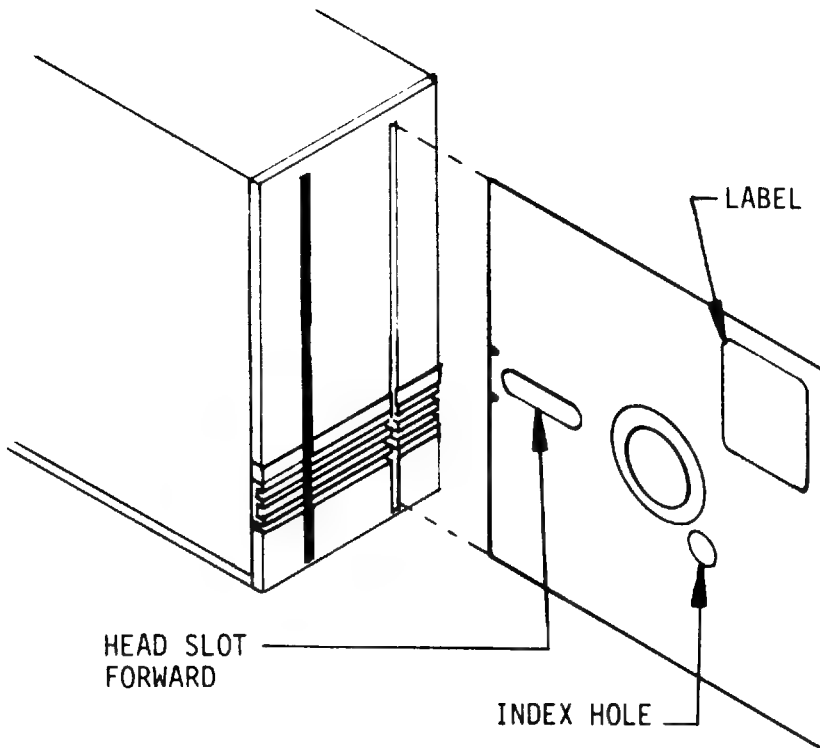


Figure 1-2. Proper Loading of Diskette

Mechanical Checks

To check the proper loading and unloading of a diskette, the diskette power cable must be connected. A button is located at the front of the bezel adjacent to the diskette aperture. When the button is pressed, the load mechanism moves to the open position and the diskette is ejected. The load mechanism will automatically close when the diskette is fully inserted.

- a. Insert a diskette and verify that the load mechanism closes.
- b. Press the button and verify that the load mechanism releases and that the diskette is ejected approximately 1/2".

CABLES

Three cables are necessary to connect power to the diskette drive and signals to the host system.

DC Power Cable

AC Power Cable

Signal Cable

DC Power Cabling

All DC power lines shall have lengths and wire diameters consistent with meeting the power regulation requirements of the diskette drive as follows:

+5V DC \pm 5%	2.0 Amps Max., 50 mV p-p ripple
-5V DC \pm 5%	0.25 Amps Max., 50 mV p-p ripple
+24V DC \pm 5%	1.0 Amps Max. seeking with 2.0 Amps Max. peak

Seven lines are used to transmit DC power through the power connector from the power supply into a diskette drive. One line pair (high and ground) is used for +5V DC, one for +24V DC, and one for -5V DC. In addition, one extra ground and one chassis ground are provided.

Five-foot lengths of #18 AWG wire are normally acceptable for use as DC power lines between the drive and typical power sources.

Fabricate and check power cable as listed for P3.

P3 - DC Power Connector

10 Pin Molex - 0.156" center

<u>Pin</u>	<u>Function</u>	<u>Pin</u>	<u>Function</u>	<u>Mating Connector</u>
1	Chassis Gnd	6	Ground	Connector Molex 09-50-7101
2	+5V DC	7	Ground	Terminal Molex 08-50-0106
3	Spare	8	Ground	Polarizing Key Molex 15-04-0219
4	Key	9	Ground	
5	+24V DC	10	-5V DC	

AC Power Cabling

AC power cabling should be fabricated from U.L. accepted cord capable of carrying 1 amp at the voltage at which the drive is to be operated.

P4 - AC Connector

3 Pin Amp

<u>Pin</u>	<u>Function</u>	<u>Mating Connector</u>
1	Motor Power "A"	Housing Amp 350766-1
2	Frame Ground	Terminal Amp 350550-3
3	Motor Power "B"	

NOTE

For reliable operation of the 299B diskette drive, or most computer peripheral equipment, an AC line filter on all AC including that to the DC power supply is required.

Signal Cabling

System connection between the controller and diskette drive is optionally connected in either a radial or daisy chain arrangement. To accommodate either application, plug-in terminators are provided.

a. Multiple Diskette Drive Applications

Terminators must be removed from all but the drive electrically furthest from the controller; the last drive terminates the line.

b. Single Diskette Drive Application

For single drive application, the terminated diskette drive is used for the diskette drive-to-controller connection. The I/O cable is simply connected to the connector.

c. Signal Cable Fabrication

1. Fabricate the interface signal cable according to Table 1-2 by using the appropriate connectors. The interface signal cable should be a twisted pair with return grounds on odd number pins. I/O wire is No. 24 or No. 26 AWG conductor, approximately 30 twists per foot, with maximum length of 20 feet. Alternately an equivalent flat cable may be used.
2. The ground side of each twisted pair terminates within a few inches of the line receiver or transmitter ground on the diskette drive.
3. Using a VOM, check each cable for pin-to-pin shorts.
4. Check for continuity between each pin and its conductor, at the opposite end of the cable.
5. After checking all cables connect them into the system.

TABLE 1.2 INTERFACE PIN CONNECTIONS
(50 PIN EDGE CONNECTOR - 0.1" CENTERS)

GND PIN	SIGNAL PIN	SIGNAL NAME
1	2	-SIDE SELECT (CUST. OPTION)
3	4	-DISKETTE SELECT 4 (DS4)
5	6	-TWO-SIDED
7	8	-INDEX
9	10	-SEEK COMPLETE
11	12	-RESTORE
13	14	-REMOTE EJECT (CUST. OPTION)
15	16	-HEAD LOAD
17	18	-DISKETTE SELECT 3 (DS3)
19	20	-INDEX/SECTOR
21	22	-READY
23	24	-DOUBLE DENSITY SYNC
25	26	-DISKETTE SELECT 1 (DS1)
27	28	-DISKETTE SELECT 2 (DS2)
29	30	-DISKETTE EJECT REQUEST (CUST. OPTION)
31	32	-PHASE LOCKED CLOCK
33	34	-DIRECTION SELECT
35	36	-STEP
37	38	-WRITE DATA
39	40	-WRITE GATE
41	42	-TRACK 00
43	44	-WRITE PROTECT
45	46	-READ DATA
47	48	-SEP. DATA (OPTION)
49	50	-SEP. CLOCK (OPTION)

Mating Connectors

<u>Vendor</u>	<u>Vendor Part Number</u>	<u>Comment</u>
Scotch Flex	3415-0000	Flat Cable
T & B Ansley	609-5005	Flat Cable
Viking	3VH25/1JN-5	Solder
Texas Instruments	H312125	Solder

INSTALL DISKETTE DRIVE

There are two methods of installing the diskette drive in a 19-inch Retma rack:

Vertical - 4 maximum

Horizontal - 2 maximum

a. Vertical 19-inch Retma Rack Installation

For vertical rack mounting the use of a slide (Figure 1-3) mounted to the top of the diskette drive is optional. If a slide is used the wide portion of the slide should be mounted to the upper inside surface of the system enclosure. The narrower portion of the slide is fastened to the upper edge of the diskette drive frame via Three 8-32 Screws 0.25 long. Tapped holes on the lower edge of the diskette drive may be used to secure the diskette drive to a holding member within the system enclosure.

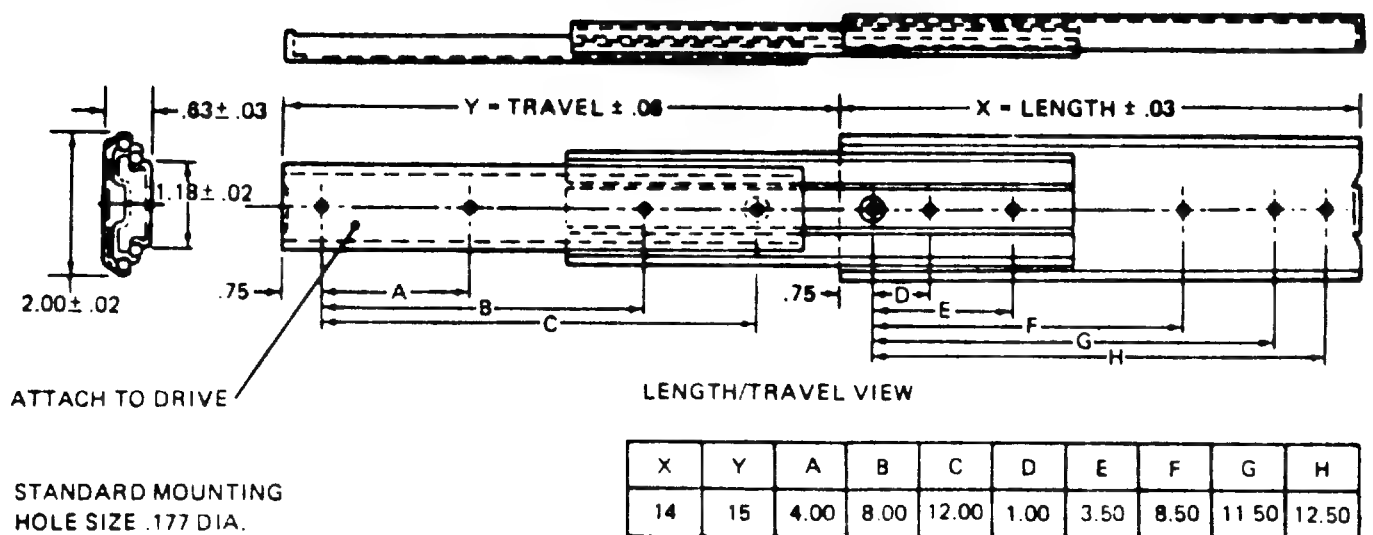


Figure 1-3. Slide Mounting Dimensions

Alternatively if a slide is not used, "skid rails" within the system enclosure may be used. Up to four drives may be mounted vertically in a 19-inch Retma rack. (Figure 1-4.) The vertical orientation of the diskette drive must be as shown. Vertical mounting of the diskette drive is preferred over horizontal mounting.

b. Horizontal 19-inch Retma Rack Installation

If two drives are mounted horizontally, "skid Rails" must be used as there is insufficient space to use slides. If a single diskette drive is mounted horizontally, two slides, one on each side of the diskette frame, should be used. The wide portion of the slide should be fastened to the system enclosure and the narrow portion to the diskette frame. The horizontal orientation of the drive is shown in Figure 1-5.

Power and signal cables may be connected to the drive prior to sliding into the system enclosure providing there is enough service loop. Or if there is rear access to the system enclosure, the power and signal cables can be installed after the diskette drive is mounted.

Drive assembly heat dissipation under maximum seek activity is 291 BTU/hr (85 watts). To limit the maximum allowable operating temperature of the media to 125 F (46.1 C), an unrestricted flow of 30 cubic feet per minute (CFM) cooling air is required.

Desk Top Mounting

The diskette drive may be desk top mounted, i.e., Positioner Vertical. Proper compensation is automatically made for the mass of the carriage assemblies.

Diskette Loading and Unloading

Proper loading of the diskette is vital to the operation of the diskette drive. Figure 1-2 shows the proper location of the diskette opening for loading.

Procedure for loading/unloading the diskette is as follows:

- a. Insert the diskette into the desired side of the diskette drive such that the label is at the opposite end of the slot from the pushbutton eject switch. A sensing device in the drive will automatically close the carrier when the diskette is inserted. Diskette 1 is on the left side of an observer facing the drive which is mounted such that the slot is vertical. Diskette 2 is then on the right side.
- b. To remove the diskette, press the pushbutton located near the slot containing the diskette. The diskette will be ejected to where it can easily be removed from the drive.

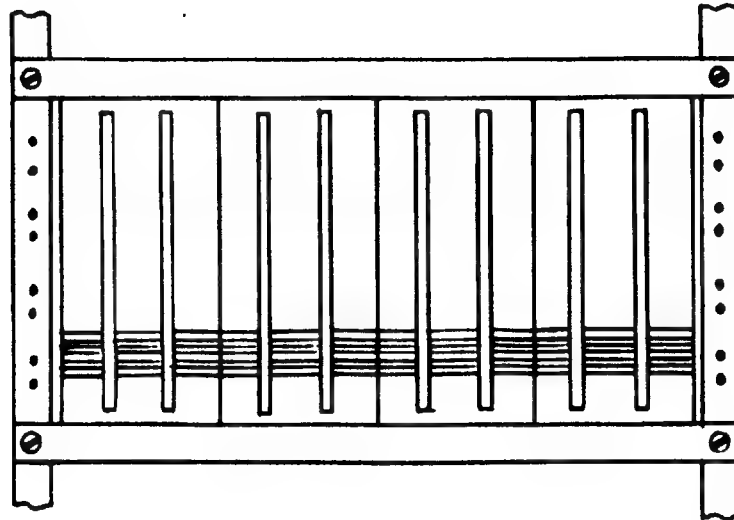


Figure 1-4. Vertical Retma Rack Mounting

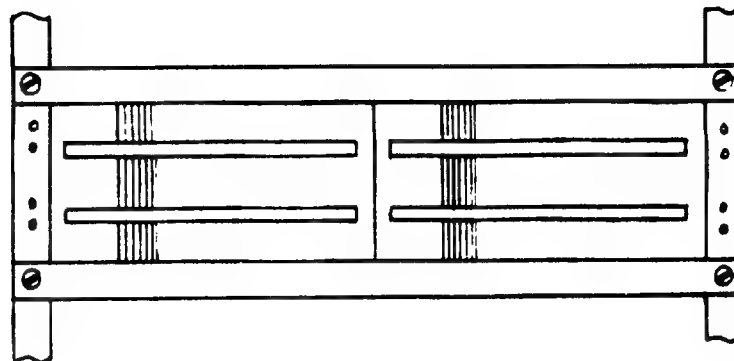


Figure 1-5. Horizontal Retma Rack Mounting

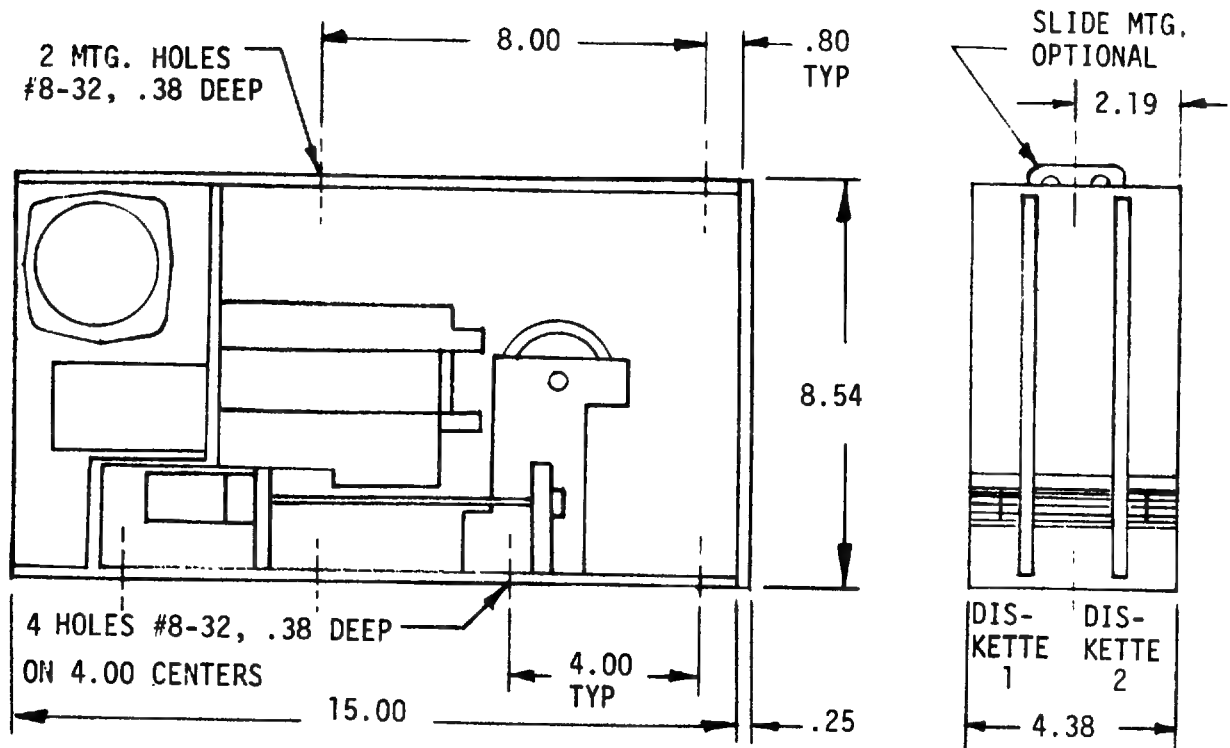


Figure 1-6. Outline Dimensions

OPTIONS

In order to meet varying requirements of different customers, PerSci provides the following Customer-Installable Options:

Chassis Ground

Chassis ground is connected to signal ground near the power connector on the drive electronics PCB. This connection is easily broken by cutting trace cut A. Trace cut A is located near the chassis grounding lead. If this trace cut is made, Pin 1 of the power connector becomes a chassis ground line only.

Drive Select Options

Four diskette select inputs and a side select input are provided. The normal configuration uses Diskette Select 1 and 2 to select the diskette, and side select to select the side of the diskette. Side select high will select the normal side of the diskette, and low the reverse side.

Two Drive Option

This normal configuration is defined as Drive 1 of 2 drives. To operate two drives in parallel, one drive must be this Normal 1 of 2, and the other must be configured as Drive 2 of 2 drives. Drive 2 uses Diskette Select 3 and Diskette Select 4 to select the diskette and side select for the side of that diskette. Drive 2 of 2 drives is Option 2. Refer to Table 1-5 for the connections required for these configurations.

One Drive (Rotary) Option

The one drive (rotary) option uses the 4 diskette select lines to select the diskette and side of the diskette. The side select line must be left high or open for this configuration.

Diskette select 1 (DS1) selects Diskette 1 Side 0 (normal), DS2 selects Diskette 1 Side 1 (reverse), DS3 selects Diskette 2 Side 0 (normal), and DS4 selects Diskette 2 Side 1 (reverse). This configuration is Option 3, and may be implemented by making the connections found in Table 1-5.

Four Drive Option

Four drives may be operated in parallel using the diskette select lines in a binary code to select each of the 8 diskettes and side select to obtain two-sided recording. In this mode of operation, DS1 is used as an enable line, low to enable; and DS2, DS3, and DS4 are decoded in a binary fashion. Diskettes are selected according to Table 1-3, Binary Selection of 4 Drives. This configuration is Option 4, and can be implemented by referring to Table 1-5 to determine the connections required by each of the 4 drives.

Eight Drive Option

Eight drives may be operated in parallel using the four diskette select lines in a binary code. See Table 1-4. If all eight drives are used, no state will be available for all drives to be de-selected, i.e., there will always be one drive selected. This configuration is Option 5 and can be implemented by making the required connections as defined by Table 1-5.

Line Termination

A 220/330 ohm resistor pack is installed in U8. This pack is used to match the impedance of the input signal line pairs. When drives are used in parallel, this resistor pack must be removed from all drives but the one electrically farthest from the controller. The 220/330 ohm resistor pack must be left in the drive electrically farthest from the controller to maintain proper line termination.

TABLE 1-3. BINARY SELECTION OF FOUR DRIVES

DS1	DS2	DS3	DS4	Drive/Diskette Drive	Selected Diskette	System Diskette Selected
HIGH	ANY	ANY	ANY	NONE	NONE	NONE
LOW	HIGH	HIGH	HIGH	1	1	1
LOW	LOW	HIGH	HIGH	1	2	2
LOW	HIGH	LOW	HIGH	2	1	3
LOW	LOW	LOW	HIGH	2	2	4
LOW	HIGH	HIGH	LOW	3	1	5
LOW	LOW	HIGH	LOW	3	2	6
LOW	HIGH	LOW	LOW	4	1	7
LOW	LOW	LOW	LOW	4	2	8

TABLE 1-4. BINARY SELECTION OF EIGHT DRIVES

DS1	DS2	DS3	DS4	Drive/Diskette Drive	Selected Diskette	System Diskette Selected
LOW	HIGH	HIGH	HIGH	1	1	1
LOW	LOW	HIGH	HIGH	1	2	2
LOW	HIGH	LOW	HIGH	2	1	3
LOW	LOW	LOW	HIGH	2	2	4
LOW	HIGH	HIGH	LOW	3	1	5
LOW	LOW	HIGH	LOW	3	2	6
LOW	HIGH	LOW	LOW	4	1	7
LOW	LOW	LOW	LOW	4	2	8
HIGH	HIGH	HIGH	HIGH	5	1	9
HIGH	LOW	HIGH	HIGH	5	2	10
HIGH	HIGH	LOW	HIGH	6	1	11
HIGH	LOW	LOW	HIGH	6	2	12
HIGH	HIGH	HIGH	LOW	7	1	13
HIGH	LOW	HIGH	LOW	7	2	14
HIGH	HIGH	LOW	LOW	8	1	15
HIGH	LOW	LOW	LOW	8	2	16

Head Load

The normal configuration is such that if a diskette is selected, the heads are loaded. Head load input, Pin 16, serves as an OR function with select; this input may be used to load the heads of the non-selected drives in anticipation of read/write activity. The normal connection utilizes a 75451 in the U26 position. Head unload is delayed approximately 5 seconds for accessing various diskettes without waiting for head load when the select comes back to the original head.

Optionally, the 75451 can be removed from U26 and a 75453 installed. This makes head load an AND function with diskette select, allowing ready, index two-sided and write protect functions of a selected drive to be monitored without loading the heads. This is Option 6.

Index/Sector

The drive normally comes from the factory wired to produce a 1 ms pulse from high to low logic level at Pins 8 and 20 each time an index or sector hole is sensed on the selected diskette. Refer to Table 1-5 for the connections of this implementation.

Independent Index/Sector Lines

Option 10 allows independent monitoring of index/sectors from each diskette of a drive. Pin 20 will have index/sector pulses from Diskette 1 and Pin 8 will have index/sector pulses from Diskette 2, when either diskette is selected. This option may be configured by making the connections found in Table 1-5.

Separated Index and Sectors

Options 11, 12, and 13 provide for separating the index pulse from the sector pulses on a hard sector diskette. 32, 16, or 8 sectors can be provided. The index pulse appears on Pin 8 while the sector pulses appear on Pin 20 of the I/O connector.

Implementation is accomplished by making the connections listed in Table 1-5.

Although only the selected diskette's index and sectors are available, separation and countdown are maintained for both diskettes to prevent loss of synchronization for an unselected diskette.

Diskette Eject

The Model 299B comes from the factory configured such that diskettes may be ejected (whenever write gate is false) either by a pushbutton switch at the bezel or, (for the selected diskette only) by a 100 ns minimum pulse or level to logic low on the signal interface Pin 14. Refer to Table 1-5 for connection details of this configuration.

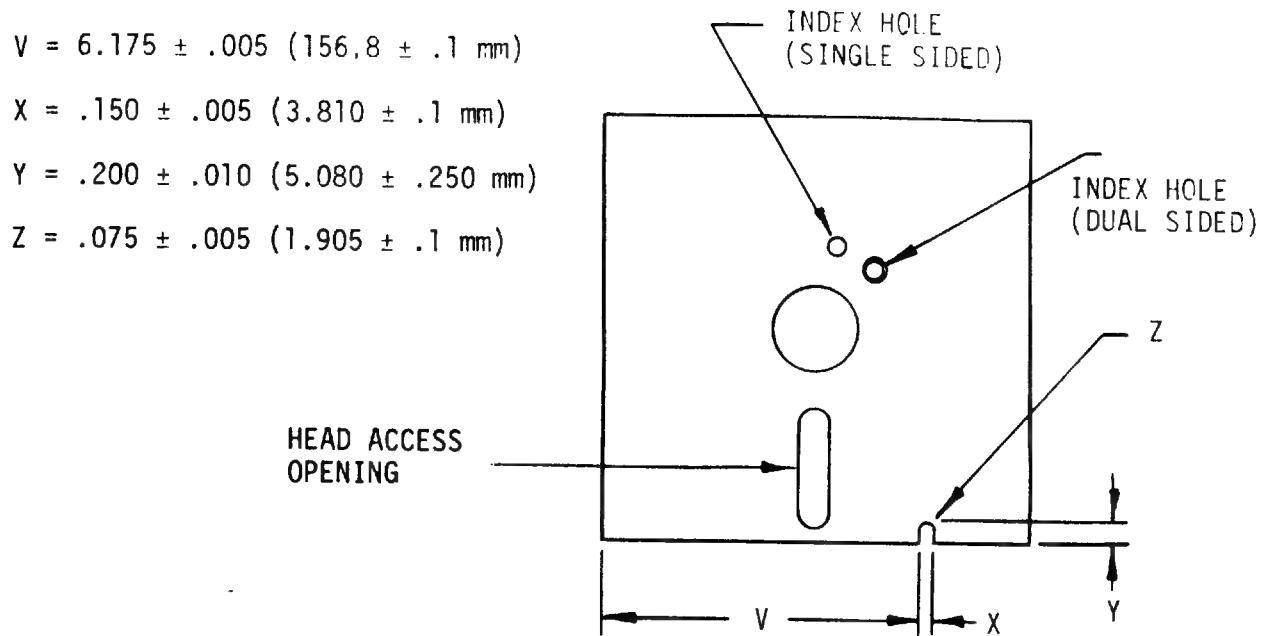


Figure 1-7. Write Protect Notch Location

Write Protect

The 299 drive as supplied from the factory implements ANSI proposed Option 1, utilizing a notched diskette. An optical sensor is installed to sense the notch in the diskette. To un-protect a diskette, cover the notch with an opaque tape (Avery DGF-K1-D-12 or equivalent). See Figure 1-7.

Writing is inhibited on a write protected diskette and the write protect output, Pin 44, is low when the write protected diskette is selected.

Customer-Installable Option 14 will prevent writing off-speed data during insertion or ejection of a diskette. Write protect logic is activated during insertion or ejection, by remote eject, or bezel switch, of either diskette. Write is inhibited and write protect output is true during these operations. If the insertion takes place while write gate is true, the carrier closure is delayed until write gate is false. If an eject command, either from the bezel switch or controller is given while write gate is true, then the eject command is ignored.

This option may be implemented by installing jumpers in G1 to G2 and G3 to G4.

Optionally, write protect can be defeated by removing U35 (AH5012). This is Option 15.

Manual Eject Inhibit

Option 9 is the manual eject inhibit option. With this configuration a logic low on Pin 30 of the signal interface will prevent ejection by the bezel pushbutton; allowing the controller to lock in a diskette until read/write operations in progress (i.e., closing files) are complete. Refer to Table 1-5 for connection details.

Diskette Eject Request

When Option 8 is configured, the function of the bezel pushbutton is changed from ejecting the diskette to producing a logic low at Pin 30. The controller can then recognize this signal and issue an eject command when all processing is finished. Refer to Table 1-5 for connection details.

Data Separation

The 299B can be ordered with no data separator, or with FM data separator; or with MFM/M²FM data separator installed.

FM Data Separator

The FM data separator uses a phase locked loop technique to properly separate clock and data pulses from the FM (double frequency) code. Proper separation is maintained over the three dropped clocks of an IBM type address mark. Separated data and separated clock pulses are synchronized to the phase locked loop. Proper separation is: data pulses always on the data line and clock pulses always on the clock line. Separated data is Pin 48 and separated clock Pin 50 of the signal interface connector.

One Shot Emulation

To function properly in controllers designed to operate with one shot data separators the phase locked data separator can be jumpered such that the clock pulses will appear on the data line, and data pulses on the clock line, after the first missing clock of an IBM type address mark. This condition continues until the first missing data pulse of the address mark; at which time clock and data pulses appear on their proper lines. Phase locked tracking and synchronization of data is maintained while emulating one shot type timing. Cut Trace A to C and install Jumper B to C on the data separator to implement this option.

Phase Locked Clock

The single density data separator provides a 250 KHz square wave phase locked to the incoming data. This signal is positive going at the leading edge of separated data and negative going at the leading edge of separated clock pulses. Except when the loop is acquiring lock there are no missing pulses on this signal. This signal may be used for very simple address mark detection and data serial to parallel conversion. To obtain this output Jumper B3 to B1 on the drive electronics PCB. The phase locked clock output is Pin 32 of the signal interface connector.

MFM/M²FM Data Separation

A data separator is available which may be used for both of these codes. A pulse appears on the separated data line, Pin 48 of the signal interface, for each data pulse in the code. These pulses are synchronized to the phase locked loop such that timing jitter due to density effects is filtered. A reconstructed clock derived from the phase locked loop appears on the separated clock line, Pin 50 of the signal interface connector.

The MFM/M²FM data separator requires a synchronizing pulse at the beginning of each field independently written on the disk. In a hard sectored system where sectors are separated and counted in the 299B, Jumpering B3 to B4 will provide this. Otherwise, Jumpering B3 to B2 will connect the sync line to Pin 24 of the signal interface connector.

FM Data Separator Adjustment

The FM data separator was adjusted at the factory, and normally needs no maintenance. The only adjustment is the VCO center frequency. This may be adjusted with potentiometer R-12. Adjust while installed using the following procedure:

1. Observe the sawtooth VCO at TP1 (Approximately 4.4V p-p). Observe the VCO control voltage (range +0.4V to -0.4V) at TP2. The oscilloscope grounds may be connected to TP5 or TP6.
2. Write a disk using either a 499B exerciser (STD. pattern) or the host system for the drive. (An all 0's FM pattern gives least phase jitter.) Read this disk for data input to the data separator.
3. Adjust R12 until the system locks the sawtooth to read data with the sawtooth at Approximately 500 KHz. (Actual frequency is determined by data frequency, $\pm 2\%$ average.)
4. Continue to adjust R12 such that the average value at TP2 is $0V \pm 50\text{ mV}$ while locked at 500 KHz. Note that ISV will cause this voltage to oscillate about ground as the loop tracks drive speed.

MFM/M²FM Data Separator Adjustment

The MFM/M²FM data separator was adjusted at the factory, it normally requires no maintenance. There are three adjustments; sync pulse, frequency, and phase.

Sync pulse is adjusted with R29, frequency with R16, and phase with R4. Adjust with the following procedure with data separator installed.

1. Prepare a disk of all 0's using either a 499B exerciser (MFM pattern) or the host system. Read this disk for data to the data separator.

2. Adjust the sync pulse at TP8 to 250 μ seconds using R29. If necessary, trigger this pulse by temporarily Jumpering B3-B4 on the drive electronics PCB. (Or jumpering Pin 24 to Pin 20 at the signal interface connector.) This is a negative going TTL level pulse.
3. Observe the VCO sawtooth at TP3 and the VCO control voltage at TP2. Oscilloscope ground is available at TP1. Adjust R16 to lock the VCO to the data with the VCO at 1 MHz. Continue to adjust R16 to center the VCO control voltage about ground (± 50 mV) while maintaining lock at 1 MHz.
4. Observe the read data pulse at TP7 and the data/clock window at TP6. Adjust the phase control, R4, to center the trailing edge of the read data pulse between the positive going edge and negative going edge of the data/clock window. Attempt to make this average setting within ± 20 nseconds.

Double Density Data Compensation

The 299B comes supplied from the factory to read MFM or M²FM coded diskettes that are written without write precompensation. The read electronics may be modified for optimum performance, when used with diskettes written with write precompensation, by configuring Option #16. Refer to Table 1-5 for this connection.

Configuration of Options

In the following table, the items listed under "Connections" are jumper points or IC's located on the drive electronics PCB. IC's are identified by a "U" number and "Type" number. The jumper points listed affect the particular function in that section only. An "*" under the jumper points indicates that an "ETCHED" jumper exists and must be cut to produce an open condition.

A "J" under a jumper point means that the two points MUST be jumpered. An "O" means that the two points MUST be open. IC's will be followed by USE or OMIT. These conditions MUST be met for any of the configurations to function properly.

TABLE 1-5.
OPTION COMPONENTS, JUMPERS, AND TRACE CUTS

FUNCTION	OPTION #	CONFIGURATION	CONNECTION						
SELECT			C1 TO C2	C3 TO C4 *	C4 TO C5	C5 TO C6 *	C7 TO C8 *	C9 TO C10 *	C11 TO C12 *
	NORMAL	DRIVE 1 OF 2	0	J	0	J	J	J	J
	2	DRIVE 2 OF 2	J	J	0	J	J	J	0
	3	1 DRIVE/NO SS**	J	J	0	J	J	J	J
	4	4 DRIVES/8 DISKETTES	--	--	--	--	--	--	--
	4-1	DRIVE 1 OF 4	J	0	J	0	J	0	0
	4-2	DRIVE 2 OF 4	0	0	J	0	J	0	J
	4-3	DRIVE 3 OF 4	J	0	J	0	J	0	J
	4-4	DRIVE 4 OF 4	0	0	J	0	J	J	0
	5	8 DRIVES/16 DISKETTES	--	--	--	--	--	--	--
	5-1	DRIVE 1 OF 8	J	0	J	0	J	0	0
	5-2	DRIVE 2 OF 8	0	0	J	0	J	0	J

**Also known as rotary select.

TABLE 1-5.

OPTION COMPONENTS, JUMPERS, AND TRACE CUTS (Continued)

FUNCTION	OPTION #	CONFIGURATION	CONNECTION						
SELECT			C1 TO C2	C3 TO C4 *	C4 TO C5	C5 TO C6 *	C7 TO C8 *	C9 TO C10 *	C11 TO C12 *
	5-3	DRIVE 3 OF 8	J	0	J	0	J	0	J
	5-4	DRIVE 4 OF 8	0	0	J	0	J	J	0
	5-5	DRIVE 5 OF 8	J	0	J	0	0	0	0
	5-6	DRIVE 6 OF 8	0	0	J	0	0	0	J
	5-7	DRIVE 7 OF 8	J	0	J	0	0	0	J
	5-8	DRIVE 8 OF 8	0	0	J	0	0	J	0
HEAD LOAD	NORMAL	DISKETTE SELECT OR HEAD LOAD I/O	U26 = 75451						
	6	DISKETTE SELECT AND HEAD LOAD I/O	U26 = 75453						

TABLE 1-5.
OPTION COMPONENTS, JUMPERS, AND TRACE CUTS (Continued)

FUNCTION	OPTION #	CONFIGURATION	CONNECTION						
DISKETTE EJECT			D1 TO D2 *	D3 TO D4 *	D5 TO D6 *	D7 TO D8 *	<u>U22</u> 75453	<u>U23</u> 75454	<u>U28</u> 75453 *
	NORMAL	BEZEL SWITCH OR REMOTE EJECT	J	J	J	J	OMIT	OMIT	USE
	7	BEZEL SWITCH ONLY (NO REMOTE)	J	J	J	J	OMIT	OMIT	OMIT
	8	EJECT REQUEST	0	J	J	0	USE	OMIT	USE
	9	EJECT INHIBIT	J	0	0	J	OMIT	USE	USE

TABLE 1-5.

OPTION COMPONENTS, JUMPERS, AND TRACE CUTS (Continued)

FUNCTION	OPTION	CONFIGURATION	CONNECTION														
INDEX/ SECTORS			A2 TO A3 *	A1 TO A3	A5 TO A6 *	A4 TO A6	A7 TO A8 *	A9 TO A10 *	A7 TO A10	A9 TO A11	B5 TO B6 *	E1 TO E2	E3 TO E4	SIDE 1 C TO -- *G	SIDE 2 C TO -- *G	U2 7474	U3 7474
	NORMAL	COMMON I/O	J	0	J	0	J	J	0	0	J	0	0	J - G	J - G	OMIT	OMIT
	10	INDEPENDENT I/O	0	J	0	J	0	0	J	J	0	0	0	J - G	J - G	OMIT	OMIT
	11	32-SECTORS (SEPARATED)	J	0	J	0	J	J	0	0	0	J	J	J - 32	J - 32	OMIT	OMIT
	12	16-SECTORS (SEPARATED)	J	0	J	0	J	J	0	0	0	J	J	J - 16	J - 16	OMIT	USE
	13	8-SECTORS (SEPARATED)	J	0	J	0	J	J	0	0	0	J	J	J - 8	J - 8	USE	USE
WRITE PROTECT			G1 TO G2			G3 TO G4			U35 - AH5012								
	NORMAL	WRITE PROTECT FOR SELECT DISK	0			0			USE								
	14	WRITE PROTECT NORMAL PLUS DURING EJECT	J			J			USE								
	15	NO WRITE PROTECT	--			--			OMIT								

TABLE 1-5.

OPTION COMPONENTS, JUMPERS, AND TRACE CUTS (Continued)

FUNCTION	OPTION	CONFIGURATION	CONNECTION	
DATA ELECTRONICS COMPENSATION			H1 TO H2 *	H3 TO H4
	NORMAL	USE WITH NO WRITE PRECOMPENSATION	J	0
	16	USE WITH WRITE PRECOMPENSATION	0	J
DOUBLE DENSITY DATA SEPARATOR SYNC			B3 TO B2	B3 TO B4
	NORMAL	EXTERNAL SYNC (SOFT SECTORED)	J	0
	17	SECTOR SYNC (HARD SECTORED)	0	J
SINGLE DENSITY PHASE LOCKED CLOCK			B3 TO B1	
	18	PHASE LOCKED CLOCK FROM F/M DATA SEPARATOR	J	

SECTION 2

MAINTENANCE

This section contains the following:

Preventive maintenance schedule and procedures.

Maintenance check, adjustment and replacement procedures.

Diskette Drive Exerciser, operating procedures and replacement.

PREVENTIVE MAINTENANCE SCHEDULE

Quarterly Cleaning

- a. Clean interior and exterior surfaces with damp cloth using a solution of non-abrasive cleaner. Clean drive belt, drive and driven pulleys with alcohol.
- b. Clean positioner scale surfaces using lint-free cloth (dry) and visually examine for foreign particles after cleaning. Foreign particles on the clear area of the velocity wedges, even minute ones, are particularly detrimental to positioner performance.
- c. Clean positioner guide rail with dry, lint-free cloth.
- d. Clean read/write head using alcohol.

Drive System Test

- a. Run available diagnostic test to verify proper operation of diskette drive.

PREVENTIVE MAINTENANCE PROCEDURES

Spindle Drive System

- a. Remove the drive belt and engage both cones by manually depressing Side 1 and Side 2 load cam shutter. With both cones engaged, the drive belt removed, and no media present, the hub assembly should rotate virtually friction-free. If friction is detected then either the hub or cone bearings are worn. The problem can be isolated by rotating the hub separately, then engaging the cones separately.
- b. Rotate drive motor shaft and check for uniformity of torque. A non-uniform rotational torque may be due to worn bearings.

Drive Belt Tension

- a. Drive belt tension is measured by applying a side force to the belt at the center of span between the crowned idler pulley and hub and measuring the deflection. Place a scale at the center of span normal to the belt. Apply a 1 lb. force to the belt using a cantilever type force gage and measure the resultant belt deflection. Belt tension is correct when the deflection is $.1 \pm .02$ inches.

Read/Write Data Amplitude

- a. Diskette operational, drive ready.
- b. Using a new IBM Diskette 2, write an all ones pattern (FM) at Track 76. Observe read data differentially at TP17 and 18, ground scope at TP8 or TP14.
- c. Output must be at least 200 mV p-p.
- d. If the proper reading cannot be obtained, the possible problem areas are:
 1. Defective write drivers.
 2. Defective media. Repeat test with a different diskette to isolate problem.
 3. Defective read/write head.

MAINTENANCE PROCEDURES

The maintenance procedures are divided as follows:

Check

Adjustment

Replacement

Tools and Test Equipment

The following material is required to perform the maintenance procedures:

- Common hand tools
- Flashlight
- Inspection mirror
- Cotton-tipped swabs (Q-Tips)
- 95% Isopropyl alcohol
- 6-inch steel scale, 1/10ths
- 0-1 oz. or 0-30 gm. force gage
- 1-lb. force gage
- Alignment Diskette - DYMEK 802-11
- Oscilloscope, Tektronix 465 or equivalent
- Drive Exerciser - PerSci Model 499B
- Kimwipes

The cognizant maintenance personnel should read the entire check, adjustment or replacement procedure prior to performing the routine.

Jacks and Plugs

The interconnecting plugs and jacks are listed in Table 2-1 and identified in Figure 2-1. The connector pins should be checked for cleanliness and total contact if intermittent problems are encountered.

TABLE 2-1. JACKS AND PLUGS

ASSEMBLY	CONNECTOR	
Drive Electronics PCB	P1	Customer Signal Interface
	J2	Voice Coil Motor Assembly
	J3	DC Power Input
	J4	Eject and Harness PCB
	J5	Servo Lamp Assembly
	J6	Mask Assembly
	J7	Data Separator
	J8	Read Write Erase PCB
Read Write Erase PCB	J1	Diskette 1 Heads
	J2	Diskette 2 Heads
	J3	Drive Electronics PCB
Data Separator PCB	J1	Drive Electronics PCB
Eject and Harness PCB 1	J1	Drive Electronics PCB
	J2	Disektte 1 Eject Motor
	J3	Carrier Switch 1, Bezel Switch 1 Activity Light 1, Index Sensor 1
	J4	Head Load Mechanism 1, Write Protect 1

TABLE 2-1. JACKS AND PLUGS (Continued)

ASSEMBLY	CONNECTOR	FUNCTION
Eject and Harness PCB 2	J1	Drive Electronics PCB
	J2	Diskette 2 Eject Motor
	J3	Carrier Switch 2, Bezel Switch 2 Activity Light 2, Index Sensor 2
	J4	Head Load Mechanism 2, Write Protect 2
	J5	Index Light Source
Deck	J4	Spindle Motor AC

Drive Electronics PCB

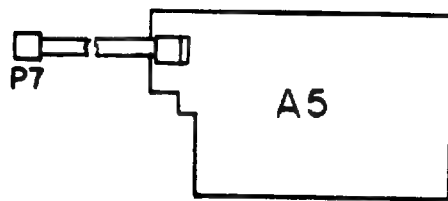
The diskette electronics PCB contains the the customer's I/O connector, DC power input connector and most of the electronics. It also serves as a distribution and gathering point for all other sub-assemblies, except the spindle motor.

PCB Replacement

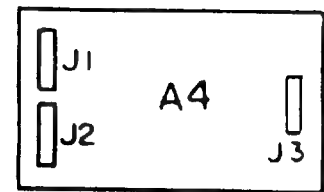
- Disconnect all the connectors along the upper board edge.
- Remove the screw holding the lower board edge to the diskette frame, and release the catch.
- Remove three screws holding the PCB hinges to the PCB.
- Install replacement PCB by reverse procedure.
- Alignment of replacement PCB to lower mounting points is achieved by slackening three screws holding hinges to PCB.

Voltage Adjustment

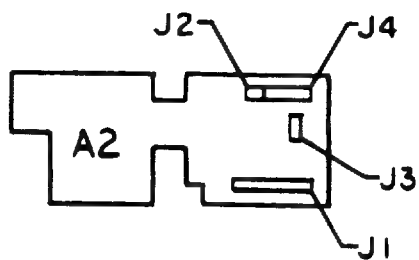
No adjustments are provided for voltage levels. If any voltage is out of tolerance, check for internal loading by disconnecting diskette drive and checking levels at controller. If levels are correct, check out cable or isolate a defective component or assembly at the drive electronics PCB. If necessary, replace the PCB.



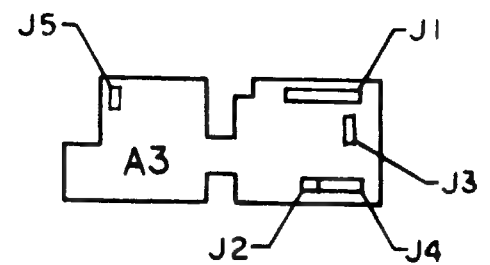
DATA SEPARATOR PCB



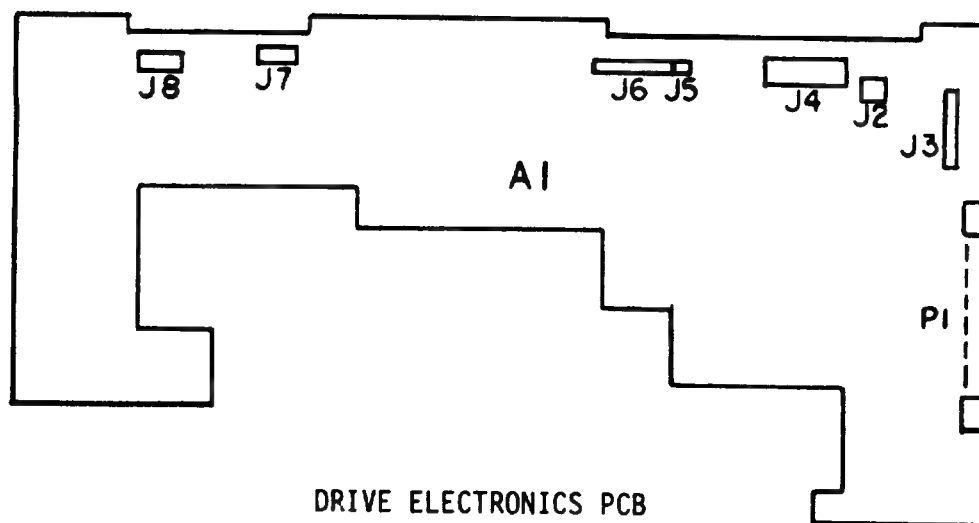
READ/WRITE MODULE PCB



EJECT AND HARNESS SIDE 1 PCB



EJECT AND HARNESS SIDE 2 PCB



DRIVE ELECTRONICS PCB

Figure 2-1. Plugs and Jacks Identification

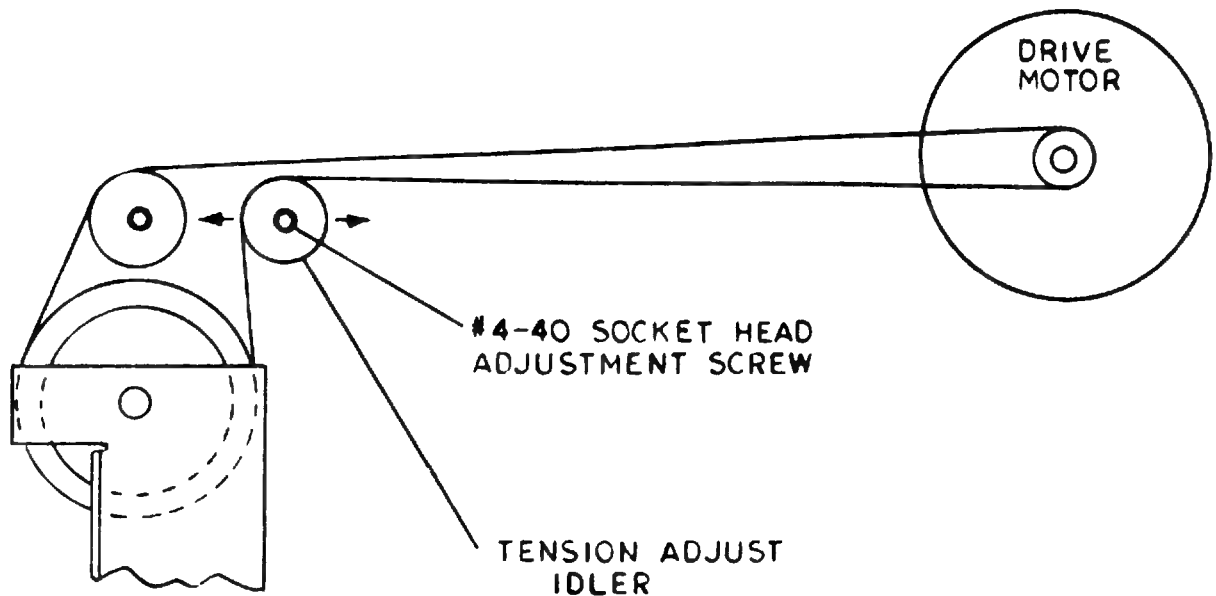


Figure 2-2. Drive System

Drive Motor and Belt Checks

- a. Set diskette power off.
- b. Inspect drive belt for wear, particularly fraying of the edges.
- c. Manually rotate drive motor. If binding is evident, replace motor.
- d. Verify belt tension.
- e. Verify drive belt tracks in center of both drive and driven pulleys; retrack belt if necessary.

Drive Belt Tension Adjustment

To adjust drive belt tension, proceed as follow:

- a. Set diskette power off.
- b. Loosen idler shaft screw. (Figure 2-2.)
- c. Slide idler shaft away from drive motor so as to tension belt.
- d. Tighten idler shaft screw and check belt tension.
- e. Belt tension is correct when the belt deflection at the center of span is $.1 \pm .02$ inches.

Drive Belt Replacement

- a. Set diskette power off.
- b. Slacken idler pulley shaft screw and slide shaft towards drive motor.
- c. Remove motor.
- d. Remove belt.
- e. Clean motor and spindle pulley surfaces, wiping sparingly with alcohol.
- f. Install replacement belt and motor, carefully placing belt around motor pulley.
- g. Re-tension belt.

Index Transducer and Logic Checks

The procedure for checking index transducer is the same for Side 1 as Side 2, only the test points and potentiometers used are different.

- a. Set diskette power on.
- b. If the drive is of "normal" configuration as defined in the options section, a $1\text{ ms} \pm 15\%$ pulse occurring once each $166.7\text{ ms} \pm 2\%$ will occur at Pin 8 and Pin 20 when a "soft sector" diskette is inserted and selected. Check with Diskette 1 selected and with Diskette 2 selected. For both sides, check that extra pulses do not occur when a diskette is inserted. Check that pulses do not occur when the selected diskette is removed (both sides). If optional interfaces are used refer to the options section to determine index/sector output characteristics.

If the drive is being used as a soft sectored drive, only Steps a and b above are required. The following steps are required only if the drive is to be used in a hard sectored environment.

- c. Index transducer alignment is checked using a DYMEK 802-11 alignment diskette. For its use read the procedure shipped with each diskette. Determine if the drive is being used with single sided or two sided diskettes. If used with single sided diskette, cover the index hole furthest from diskette center line with a write protect tab or an opaque tape. If it is to be used with a two sided diskette, cover the middle index hole. If both types of diskettes are to be used the alignment must be performed each way.
- d. Insert DYMEK alignment Diskette 802-11 into Side 1.
- e. Access Track 73 and load head assembly Side 1 and select Head 1.
- f. Monitor read data at TP13 on the drive electronics board grounding the probe at TP14.

- g. Sync to leading edge of index pulse at Pin 20 of P1 on the drive electronics board.

PROG:	INDEX TRANSDUCER
SYNC:	EXT CH 2 NEG
CH 1:	.5V/DIV A.C.
MODE:	CH 1 50 μ SEC.

- h. The start of the data burst should lag the negative going edge of the index pulse by 200 μ sec \pm 100 μ sec.

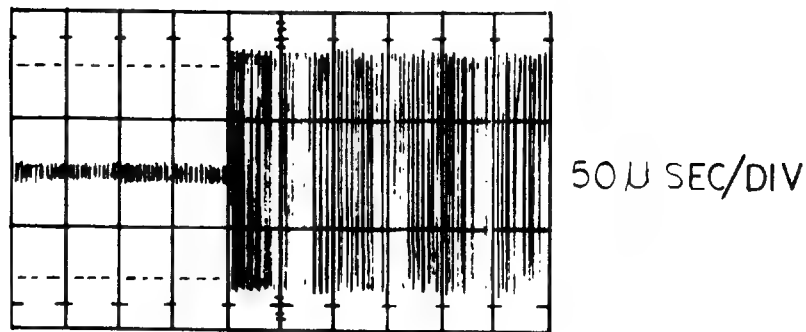


Figure 2-3. Index Pulse and Data Burst

- i. This is true for both Track 73 and Track 1. Any difference in reading between these two tracks is due to machine azimuth; azimuth should be checked before aligning the index transducer.
- j. Variations in reading will occur with successive insertions of the diskette and an average reading should be taken. Excessive variations with diskette insertion, i.e., greater than $\pm 50 \mu$ sec, indicate a media concentricity or registration problem. If this occurs, perform the spindle cone check outlined on Page 2-10. The timing should remain between 100 μ sec and 300 μ sec for all cases.
- k. To check index Side 2 load DYMEK alignment diskette into Side 2 and select Head 3. Leave scope probe at TP13 and repeat Steps e thru j.

Index Transducer Alignment

This alignment is not required for drives used in soft sector environment. To align the index transducer, sync from leading edge of index pulse and monitor data burst on the DYMEK alignment diskette 802-11 as described in the index transducer check procedure.

- a. Alternately access Tracks 1 and 73.
- b. Observe time interval between negative edge of index pulse and data burst.

- c. Adjust R4 until time interval is $200 \pm 100 \mu\text{sec}$ for single sided diskettes, and R8 until time interval is $200 \pm 100 \mu\text{sec}$ for two sided diskette adjustment at Track 1. (Use R12 and R15 for Side 2 adjustments.) Verify that it is $200 \pm 100 \mu\text{sec}$ at Track 73.
- d. Check with successive insertions of diskette that time interval remains $200 \pm 100 \mu\text{sec}$ at Track 1.
- e. If this time interval cannot be achieved by adjustment of the photosense electronics, then proceed as follows:
 1. Position the photosense as close to the correct position without losing signal.
 2. Remove diskette.
 3. Manually load the cone by pressing the carrier in and observe the alignment between the photosense and lamp module.
 4. Slacken two screws holding photosense assembly to deck plate and reposition such that the photosense and lamp are opposite each other.
 5. Insert diskette and proceed with alignment from Step a.

Index Transducer Replacement

The index transducer consists of two elements - the photosense assembly and a common lamp assembly.

To replace the photosense assembly proceed as follows:

- a. Set diskette power off.
- b. Unsolder the yellow, blue, and green leads at the photosense assembly observing lead polarity.
- c. Remove No. 4 allen cap screws securing photosense assembly to carrier and install replacement assembly.
- d. Solder leads, observing same polarity as on the replaced assembly.
- e. Perform index alignment procedure.

To replace the lamp assembly proceed as follows:

- a. Disconnect P5 from eject and harness PCB 2.
- b. Remove two screws securing lamp assembly to deck plate, being careful not to disturb lens alignment.
- c. Remove lamp assembly and install replacement assembly.
- d. Check index alignment.

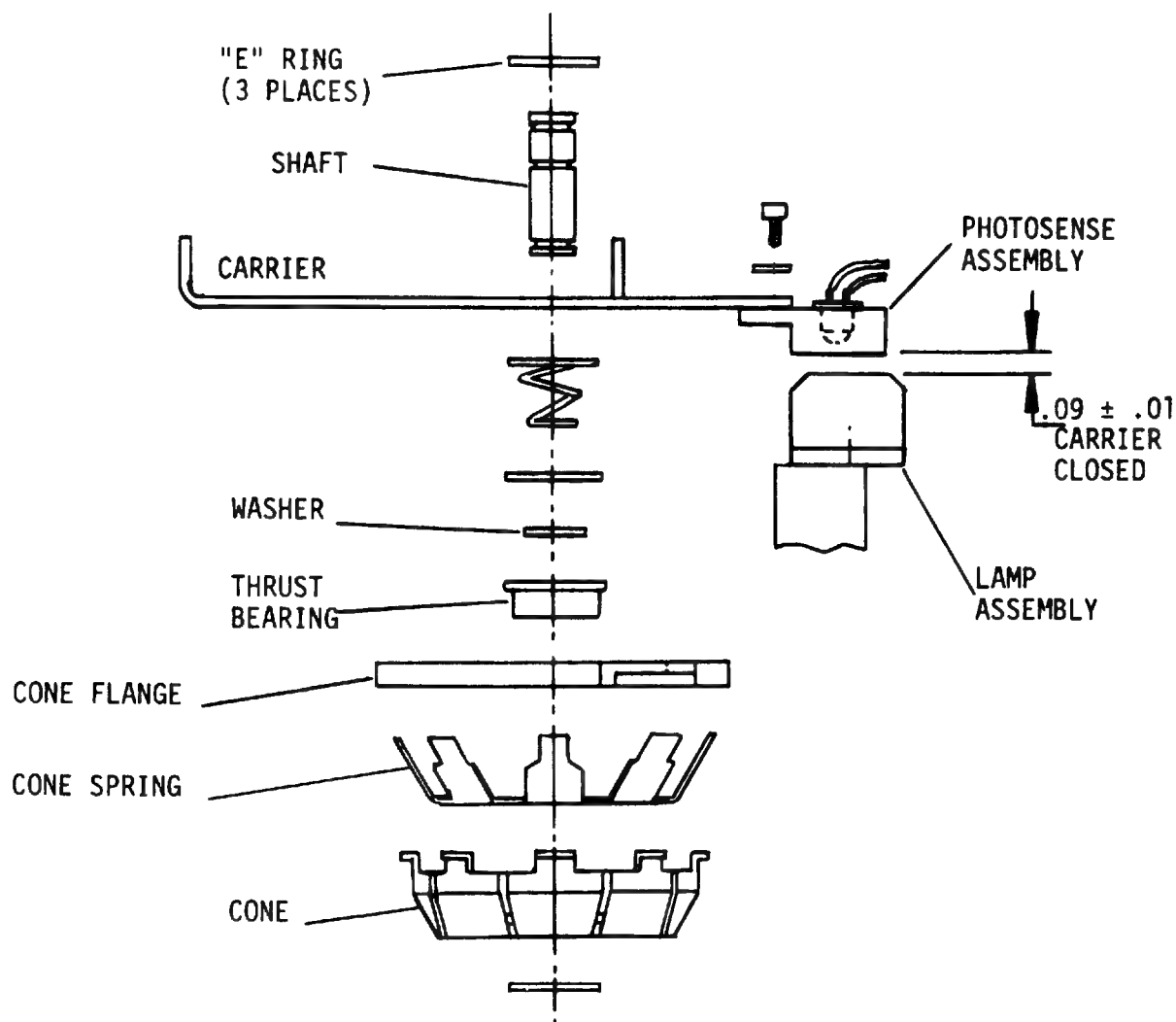


Figure 2-4. Index Transducer and Cone Assembly

Spindle Cone Check

- a. Connect the Channel 1 scope probe to TP13 on the diskette electronics PCB and ground at TP14 and the trigger probe to P1-20. Set the scope controls as follows:

MODE:	CH 1
VOLTS/DIV:	0.2 (10X probes) AC
SECONDS/DIV:	20 mS
TRIGGER SOURCE:	EXT
TRIGGER COUPLE:	AC, NORM
TRIGGER SLOPE:	(-)

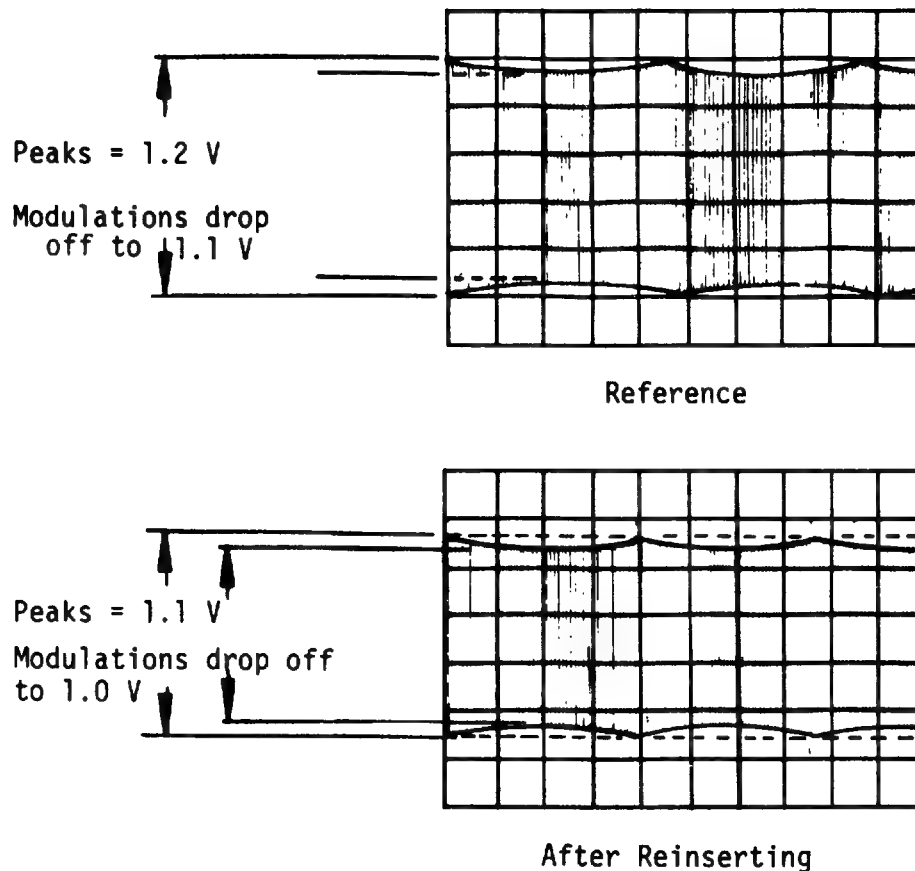


Figure 2-5. Example of Good Cone

$$\frac{1.1}{1.2} = 92\% \text{ Peaks} \quad \frac{1.0}{1.1} = 91\% \text{ Modulations}$$

- b. Insert an IBM Diskette 1 or Diskette 2 which is known to have a good center hole, position to Track 0, select Side 1, and write a 1's pattern and 0's pattern.
- c. Carefully notice the amplitude of the signal and the modulation characteristics. You will be looking for changes in amplitude and modulation characteristics, so study them before proceeding.
- d. Eject the disk, then reinsert it. DO NOT WRITE again. Look for lower amplitude or increased modulation. If the amplitude of the entire signal or if any modulation decreases by 10% or more, the cone is bad. Eject then reinsert the disk ten times. If the cone looks bad any one of the ten times, it's bad and must be replaced.
- e. Repeat a thru d for Side 2.

Spindle Cone Replacement

The cone assembly engages the media with the drive hub. The cone assemblies for Side 1 and Side 2 are the same and the replacement procedures are the same. To replace the cone or any other part within the assembly, proceed as follows:

- a. Set diskette power on.
- b. Manually depress the optical load shutter, thus engaging the cone with the hub.
- c. Remove E ring holding the cone assembly to the carrier. (Figure 2-4.)
- d. Press the eject button, i.e., carrier in disengaged position.
- e. Remove cone assembly, compression spring, and shim washer, between the spring and carrier.
- f. Dismantle cone assembly by removing E ring next to the thrust bearing.
- g. Install replacement cone and assemble by reverse procedure.

Positioning System

The positioner servo comprises a voice coil actuator, optical transducers, carriage assembly and the electronics required to control the system. Positioner circuits are located on the drive electronic PCB. (See Figure 2-6.)

Positioner Servo Check

Using the oscilloscope, observe the position transducer output at TP4. A signal swing of $3.25 \pm .25V$ p-p is expected. Ground the oscilloscope at TP2. Synchronize the oscilloscope to the positive going edge of seek complete, available at a test point of the 499B exerciser or at P1 Pin 10, the signal interface connector to the drive.

After connecting the oscilloscope, alternately seek between Track 00 and Track 76, using the diskette drive exerciser in SL mode. Verify that each seek requires $100 \text{ ms} \pm 5 \text{ ms}$, that the positioner transducer output is $3.25 \pm .25V$ p-p minimum during seek and that the positioner transducer signal is balanced within $\pm 100 \text{ mV}$ about ground. Observe at 0.5V per division on the oscilloscope.

Step sequentially from track to track with the diskette exerciser, using step mode. Verify that the positioner settles within 0.5 divisions within 10 ms, and that there are no overshoots greater than 0.5 divisions. (Observe at 0.5V per division.)

Seek in crescendo mode, automatic, with the exerciser for at least two cycles to verify settling to each track from a high speed seek.

Head Assembly Track Alignment and Machine Azimuth

- a. Set diskette power on.
- b. Load DYMEK alignment diskette 802-11 into Side 1.
- c. Access Track 76 and load head assembly Side 1.
- d. Monitor read data Head 1.

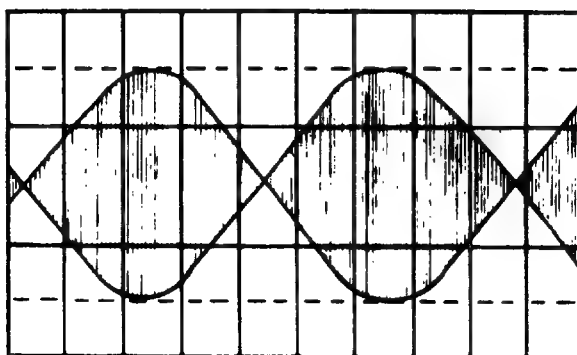
PROG:	TRACK ALIGNMENT SIDE 1
SYNC:	EXT INDEX PULSE NEG. (PIN 20)
CH 1:	50 mV/DIV A.C.
MODE:	CH 1, 20 mSEC/DIV

Scope probe CH 1 to TP13 on data and interface PCB. Hook probe ground to TP14.

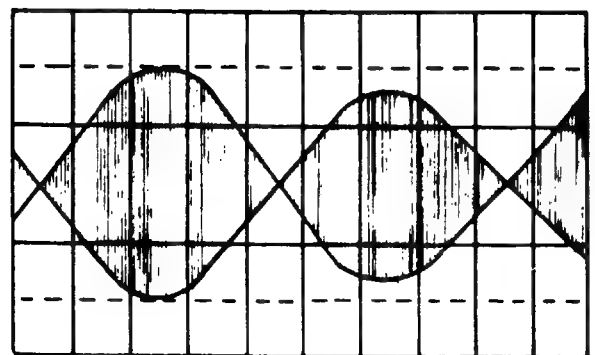
- e. If track alignment is perfect the amplitudes of the cat's eye pattern will be equal. A 30% amplitude difference represents a $1\frac{1}{2}$ mil position error. (Figure 2-6) $1\frac{1}{2}$ mil is the maximum tolerable error.

Machine azimuth is important to, and need only be checked for, hard sector drives. Delete tests f, g, h, and i for soft sector drives.

- f. Access Track 73 and load heads assembly Side 1 still using alignment diskette. Set up as in "Index Transducer and Logic Checks" Page 2-7.
- g. Observe time interval between sync and data burst. (Figure 2-3.)
- h. Access Track 1 and observe any change in this time interval.



EVEN AMPLITUDE 100% ON TRACK



70% AMPLITUDE $1\frac{1}{2}$ MIL OFF TRACK

Figure 2-6. Track Alignment

- i. If machine azimuth is correct the time interval should be the same within 100 μ sec.

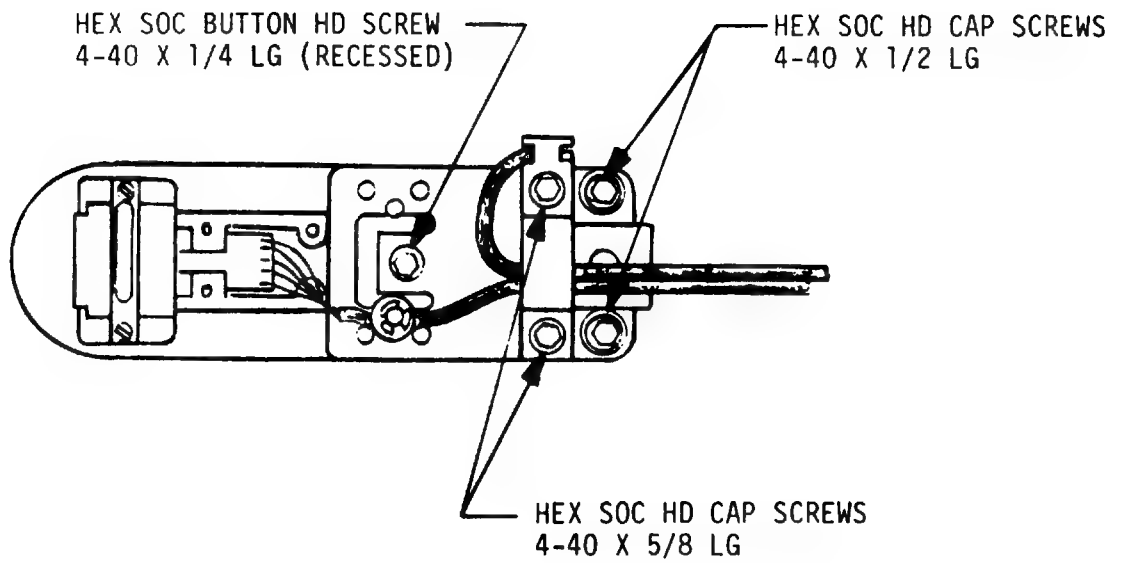


Figure 2-7A. Head Assembly Mounting Screws Side 2

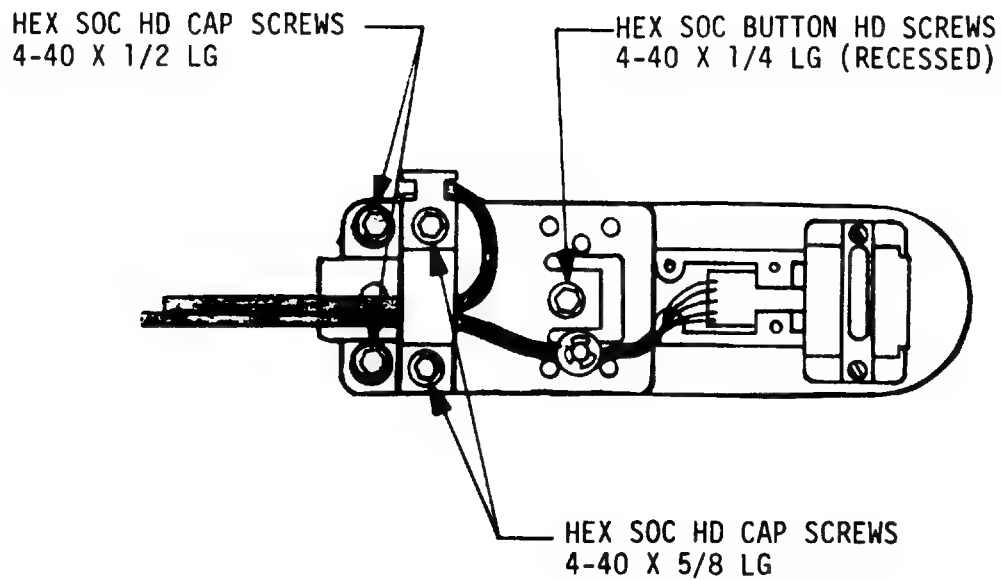


Figure 2-7B. Head Assembly Mounting Screws Side 1

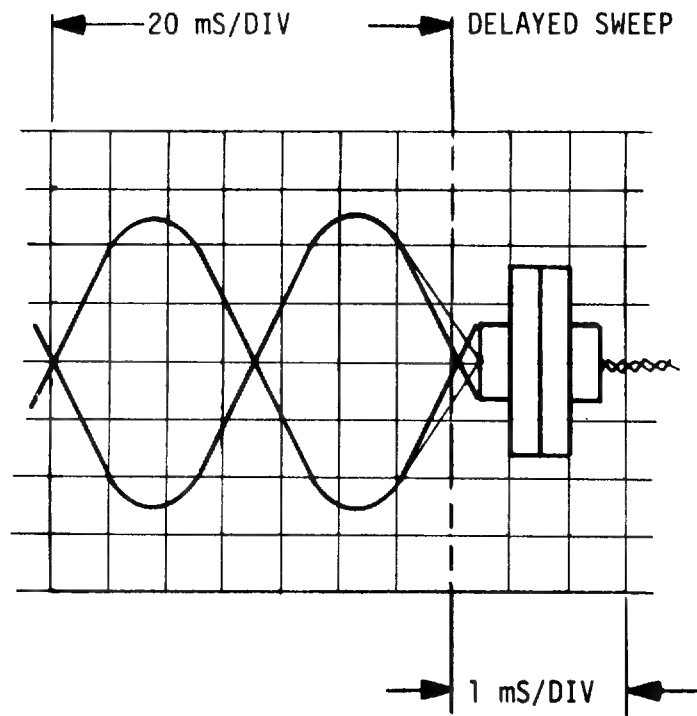


Figure 2-7C. Cat Eyes and Head Azimuth Display

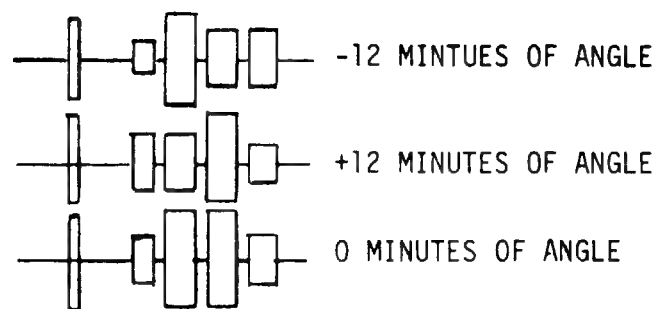


Figure 2-7D. Head Azimuth Alignment

- j. Select Side 1 and repeat Steps c through i.
- k. Repeat Steps c through j except with the 802-11 alignment diskette in Diskette 1 position and taking the index pulse from P1 Pin 8. (If separated index option, take index at Pin 20.)

Positioner Servo Adjustment

If the positioner servo did not pass the check of the preceeding section, alignment might be required.

Preliminary Adjustments

The positioner servo adjustments are located on the drive electronics PCB. (Figure 2-8) Before performing the preliminary adjustments, unplug P2 from J2 on the drive electronics PCB.

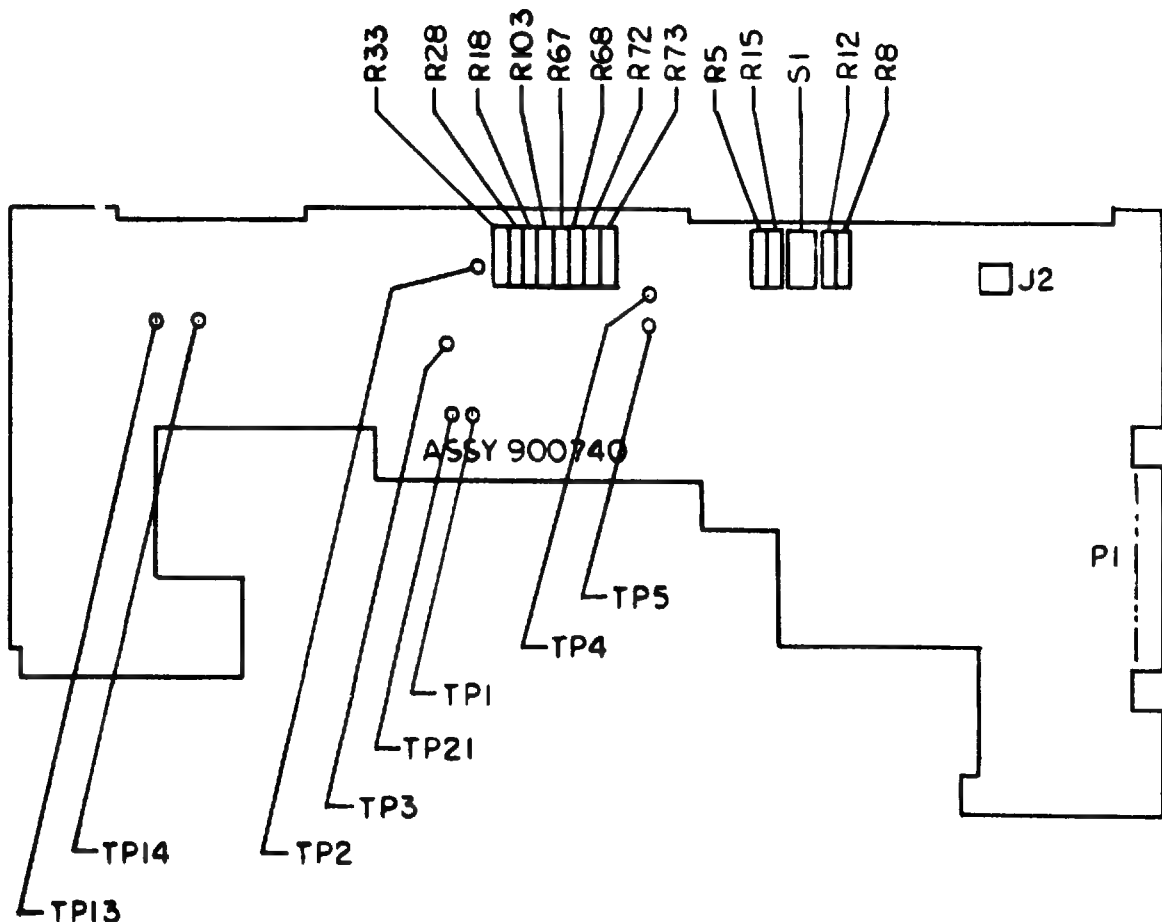


Figure 2-8. Drive Electronics PCB

TABLE 2-2. POSITIONER SERVO PRELIMINARY ADJUSTMENTS

FUNCTION	CONTROL	TEST POINT	ADJUSTMENTS
Lamp voltage is normally only adjusted on installtion of new lamp. These two settings are servo controlled to compensate for temperature and age; they normally vary from initial setting - <u>DO NOT RESET IF OTHER SETTINGS ARE CORRECT.</u>			
Lamp Voltage	R-28	TP1	Set to $2.5V \pm .1V$
	R-18	TP1	Move positioner back and forth over the full stroke and set R-2 for <u>minimum</u> variation in lamp voltage. Expect to obtain less than 50 mV variation over the stroke. Reset R-28 for $2.5V \pm .1V$ at TP1.
Velocity Gain	R-33	TP3	Adjust for a 1.25V DC-swing over the full stroke. Should be more negative toward Track 76.
Fine Position	R-67, R-68	TP4	Adjust for 3.25V p-p $\pm .25V$ balanced about ground as positioner moved back and forth by hand. R-67 is balance and R-68 is gain.
Track Sense	R-72, R-73	TP5	Adjust the bottom of sawtooth waveform to $.0V \pm .1V$ at Tracks 2 through 76 (will be triangle wave approximately .5V p-p), and $-1.25V \pm .1V$ at Track -1. With servo coil connected, set TK 00 voltage at $.75V \pm .05V$ and make sure the bottom of sawtooth waveforms are still at 0V. R-72 is balance and R-73 is gain.
Oscilloscope Ground		TP2	

Final Adjustments

The adjustments of the preceeding sections should be sufficient for operation, but for attaining specified performance levels track sense and speed should be adjusted dynamically. Also, forward and reverse speed is balanced by adjusting R-103 on the positioner servo PCB.

Move the oscilloscope probe to TP4, and oscilloscope ground to TP2 on the diskette electronics board. Alternately seek from Track 64 to Track 1. Synchronize the oscilloscope to the positive edge of the "seek complete" signal found at a test point on the exerciser or at P1-10 on the data and interface PCB. Adjust R-103 for best symmetry between forward and reverse seeks.

Sync on the negative edge of "seek complete" TP on the 499B exerciser or P1-10 of the drive electronics PCB. Alternate seeks between Track 00 and Track 76, keeping oscilloscope functions as they were, except for time. Adjust R-10 such that the time for the longer seek (forward or reverse) to settle within .25V of ground is 95 to 100 ms. This completes the adjustment of positioner servo.

Head Assembly Track and Head Azimuth Alignment Side 2

- a. Use a write protect label or equivalent to cover the dual sided index aperture on a DYMEK 802-11 alignment diskette.
- b. Loosen 4-40 X 1/4 recessed screw holding Side 2 head assembly to carriage.
- c. Access Track 76.
- d. Insert alignment diskette Side 2.
- e. Monitor read data at TP13, using a Tektronix 465 or equivalent scope which has a mixed sweep feature. Trigger scope external negative off index. Set main time base to 200 msec/div and delayed time base to 1.0 msec/div. Select Head 4 (fixed button head).
- f. Loosen two 4-40 1/2 cap screws holding Side 1 head assembly to carriage. See Figure 2-7A.
- g. Adjust assembly for correct head azimuth. See Figure 2-7C. Head azimuth is within acceptable tolerance when the data bursts seen on the delayed time base indicate the head is within ± 12 minutes of true position. However, head azimuth interacts with machine azimuth: therefore, for head sector drives best results are obtained by setting head azimuth as close as feasible. This gives best tolerance of parameter variation. If necessary, to meet machine azimuth timing by cancelling tolerances, head azimuth may be relaxed to ± 12 minutes of arc.
- h. Tighten two 4-40 X 1/2 cap screws.
- i. Remove diskette.
- j. Tighten 4-40 X 1/4 recessed screw.
- k. Re-insert alignment diskette and check head azimuth.

- l. Adjust track alignment by loosening two 4-40 cap screws holding the position transducer to the main casting. Radial track alignment is correct when the lobes of the cat's eyes seen on the main time base are equal or within 70% of each other's amplitude.
- m. Tighten two 4-40 cap screws.

NOTE

The position transducer is used to set radial track alignment on Head 4 only. After this has been set the transducer should not be moved.

- n. Loosen two 4-40 X 5/8 cap screws holding Head 3 to Head 4.
- o. Monitor read data Head 3.
- p. Insert alignment diskette and access Track 76.
- q. Adjust head for correct radial track and head azimuth alignment.
- r. Tighten two 4-40 X 5/8 cap screws and check alignments.

Head Assembly Track and Head Azimuth Alignment Side 1

NOTE

Side 2 head assembly must be properly aligned before Side 1 can be aligned.

The procedure for alignment is the same as Side 1 except that radial alignment of Head 1 (fixed button head) is accomplished by moving the assembly radially rather than moving the transducer assembly.

Load Cam Shutter Alignment

- a. Set diskette power on.
- b. Manually depress the load cam shutter to allow the carrier to close.
- c. Depress the eject button on the bezel to allow the carrier to open.
- d. Observe how the pin from the top of the shutter rides on and comes to rest on the motor cam when the carrier is fully open.
- e. The shutter pin should be parallel to the flat on the cam, in this open position. (See Figure 2-9.)
- f. Loosen the 4-40 slotted screw on the bottom of the casting and near the front of the eject and harness PCB. Pivot the board in or out slightly to adjust the shutter to cam timing. Re-tighten the 4-40 screw to secure the PCB.
- g. Repeat Steps b through e to check the adjustment.

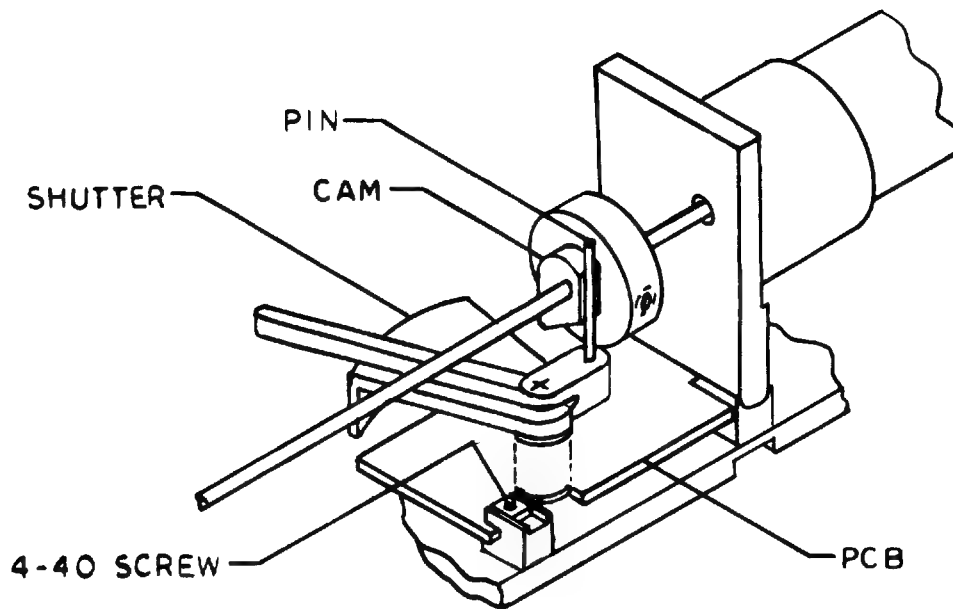


Figure 2-9. Load Cam Shutter Alignment

Eject Motor Cam Alignment Check

- a. Set diskette power on.
- b. Manually depress the load cam shutter.
- c. Observe the crank cam moves to a bottom dead center position relative to the carrier plane, i.e., maximum penetration of cone assembly into hub. (See Figure 2-10B.)
- d. Depress eject button on bezel and observe the crank cam rotate to a point where the bearing follower is just clear of impacting the carrier plane, i.e., 0 - .03". Once the carrier is open there must be no further contact between the bearing follower and carrier. (See Figure 2-10A.)
This check does not apply to drives with S.N. above D3500.

Crank Cam Alignment Check

The crank cam angular alignment is determined by the motor cam alignment. To check for cam penetration proceed as follows:

- a. Set diskette power on.
- b. Manually depress the load cam shutter.
- c. Observe the gap between the E ring which holds the cone assembly to the carrier and the corresponding carrier surface. (See Figure 2-11.)
- d. With the carrier in the loaded position the gap should be $.035 \pm .0015$ ".

Crank Cam Alignment Procedure

- a. Slacken two No. 8 slotted screws securing motor bracket to deck casting flange.
- b. Set diskette power on.
- c. Manually depress the load cam shutter and observe gap described in Paragraph c of check procedure.
- d. If incorrect, slacken two No. 4 slotted screws holding motor shaft support to deck casting flange.
- e. Displace arm, tighten screws and check alignment.
- f. Repeat until desired alignment is achieved.
- g. Tighten 2 motor bracket screws after aligning support arm.
- h. After aligning the crank cam check the space between the photosense assembly on the carrier and the lamp assembly on the deck plate. With the carrier in the loaded position this should be $.09 \pm .01$ ". (Figure 2-4.) There is no adjustment for this. If the dimension is incorrect, deform the carrier sheet metal between the cone and photosense assembly.

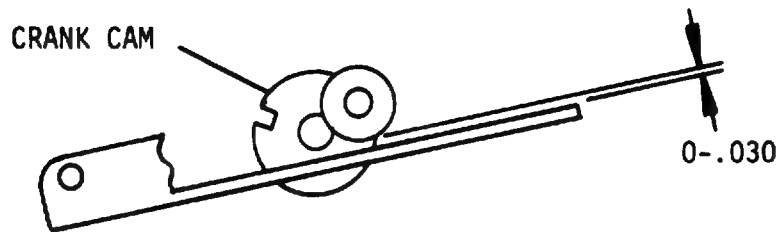


Figure 2-10A. Eject Motor Cam Alignment Check-Carrier Open

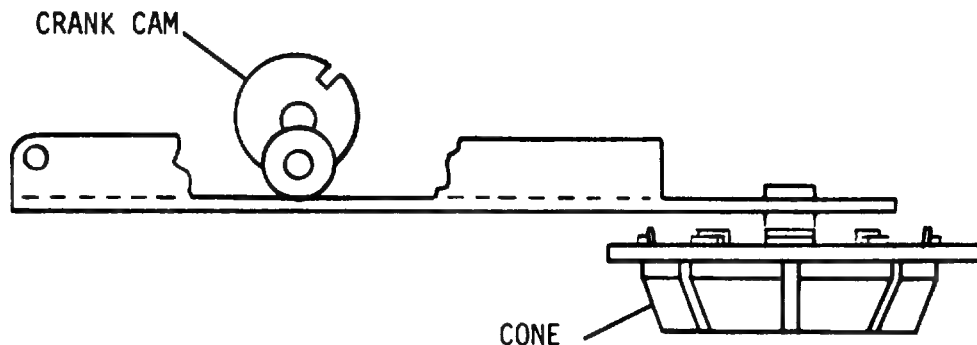


Figure 2-10B. Eject Motor Cam Alignment Check-Carrier Closed

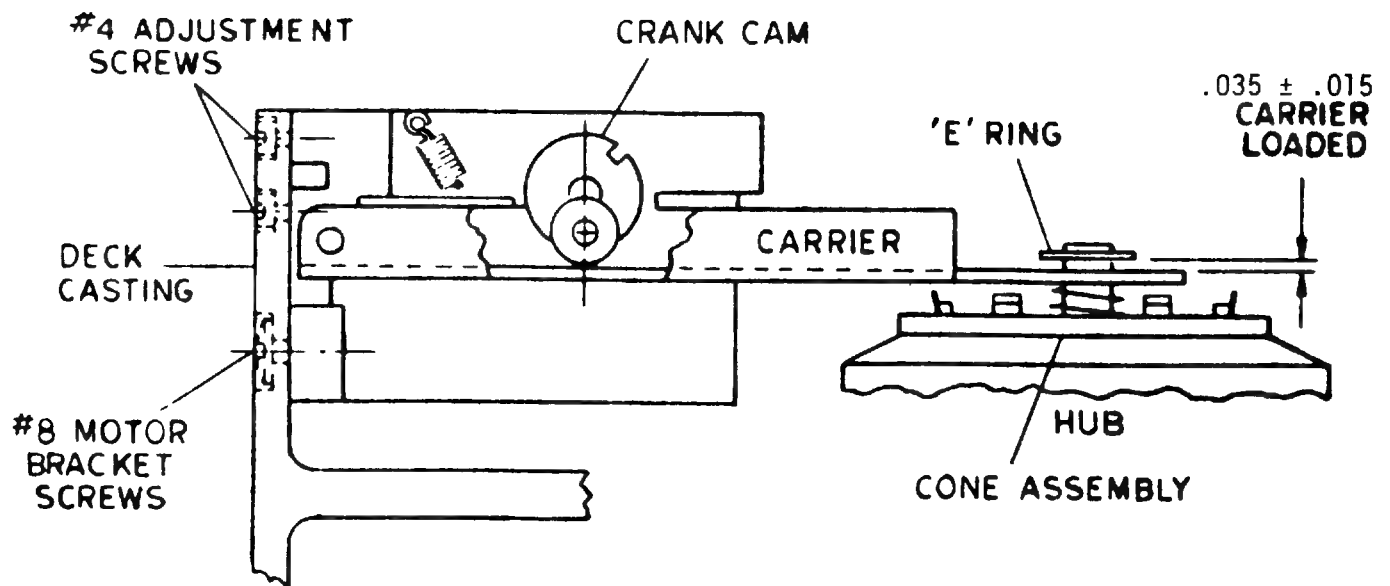


Figure 2-11. Crank Cam Alignment Check

DISKETTE DRIVE EXERCISER

Maintenance checks and adjustment procedures can be accomplished on-line using the controller or off-line using the Model 499B Diskette Drive Exerciser. (See Figure 2-11.)

Controls, Indicators, and Test Points

The exerciser controls, indicators, and test points are described in Table 2-3.

Figure 2-12. Control Panel, Diskette Exerciser, Model 499

TABLE 2-3. EXERCISER SWITCH, INDICATOR AND TEST POINT FUNCTIONS

SWITCH INDICATOR OR TEST POINT	FUNCTION
POWER SWITCH	Toggle Switch. UP for Power ON, DOWN for Power OFF.
EXECUTE SWITCH	Pushbutton Switch. Pressing this button causes the execution of any of four SEEK Functions selected by Seek Mode Switch.
SEEK MODE SWITCH	Four Position Rotary Switch. <u>LOAD</u> position ENABLES Resetting the Seek Address Register according to "Load Switches". <u>SL</u> position programs seeks to alternate between the address in the "Seek Address Register" and any address on the "Load Switches". <u>STEP</u> position programs seeks to successively go to the next higher numbered track until Track 76 is reached, then seeks successively go to lower numbered tracks until Track 1 is reached, and then the process repeats. <u>CRESCENDO</u> programs seeks to alternate between Track 00 and successively higher numbered tracks until seeking Track 76, then alternate between Track 00 and successively lower numbered tracks until Track 01 is reached, and then repeat.
LOAD ADDRESS SWITCHES	Seven Toggle Switches. Each switch binary is weighted, weights silk screened below the switch. Switches are used to program Seeks as described in the discussion of the "Seek Mode Switch". The UP position is true; DOWN is false.
RESTORE SWITCH	Pushbutton Switch. Pressing this switch clears the Address Registers in the Exerciser, and holds them Cleared until a Track 00 signal arrives from the Drive under test, or the "Stop Seek" switch is pressed.
STOP SEEK SWITCH	Pushbutton Switch. Pressing this Switch clears a Restore command or a Seek command from the Exerciser.

TABLE 2-3. EXERCISER SWITCH, INDICATOR AND TEST POINT FUNCTIONS

SWITCH, INDICATOR OR TEST POINT	FUNCTION
AUTO, MANUAL SWITCH	Toggle Switch, in DOWN (Manual) position an SL Step, or Crescendo Seek is performed each time Execute is pressed. In UP (Auto) position, pressing Execute starts the first Seek, 20 ms after the completion of the first and each succeeding Seek a new Seek is initiated until the Switch is put back to Manual or Stop Seek is pressed.
SELECT SWITCH	Toggle Switch. UP Position selects Side 0 on Dual; DOWN position selects Side 1.
EJECT SWITCH	Pushbutton. Pressing this switch ejects diskette from side selected by Select Switch, if Remote Eject option is installed in drive.
PATTERN SELECT SWITCH	Three position Rotary Switch. Selects which of six unformatted patterns can be written on the diskette. The patterns are all 0's, FM, alternating bytes of 1's and 0's, FM, and all 1's, FM, all 0's, MFM all 1's, MFM, and groups of 3 1's, MFM.
CONTINUOUS WRITE SWITCH	Pushbutton. Holds Write Gate ON continuously while pressed, data as selected by Pattern Select Switch is transferred. Destroys format on diskette.
SINGLE PASS WRITE SWITCH	Pushbutton. Causes Write Gate to come on from the trailing edge of one index to the trailing edge of the next index. Data as selected by the Pattern Select Switch is transferred. Destroys format on diskette.
TRACK ERASE SWITCH	Pushbutton. Causes drive to hold Write current of one polarity for one revolution, thereby erasing data and format from diskette.
HEAD LOAD SWITCH	Toggle Switch. Putting this switch UP gives a Head Load Command. (Some diskette drives have Head Load combined with Select; this switch is non-functional under this condition.)
SEEK ADDRESS INDICATORS	Seven LED's binary weighted, to indicate the address loaded into the Seek Address Register. Binary weight just below each LED.

TABLE 2-3. EXERCISER SWITCH, INDICATOR AND TEST POINT FUNCTIONS

SWITCH, INDICATOR OR TEST POINT	FUNCTION
PRESENT ADDRESS INDICATORS	Seven LED's, binary weighted, to indicate the address the drive is on, or is in the process of seeking.
TRACK 00 INDICATOR	A LED used to indicate when the drive is on Track 00.
GROUND TEST POINT	Eight Test Points are provided for Oscilloscope Ground.
+24V TEST POINT	+24 Volts is available at the Test Point for monitoring.
+5V TEST POINT	+5 Volts is available at this Test Point for monitoring.
-5V TEST POINT	-5 Volts is available at this test point for monitoring.
SEEK COMPLETE TEST POINT	Monitors Seek Complete signal returned from drive.
WRITE DATA TEST POINT	Monitors Write Data sent to drive.
READ DATA TEST POINT	Monitors unseparated Read Data from drive.
INDEX TEST POINT	Monitors Index Pulses from drive.
DRIVE	Rotary Switch. This switch selects the drive or side corresponding to the number of the switch position for Model 70, 277, or 299 drives.
STEP RATE	Toggle Switch. This switch selects 500 KHz (FAST) as the step rate for Model 70, 277, or 299A drives; or 7,8 KHz (SLOW) for 299B and 288 drives.
TWO SIDED	A LED used to indicate that a two sided diskette has been inserted in 299 and 288 drives.

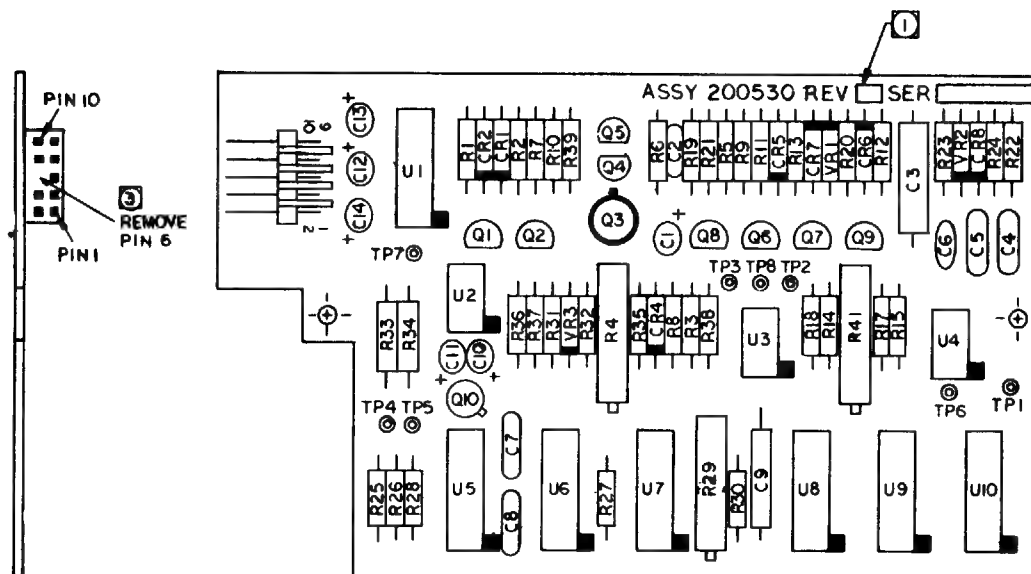
DRAWINGS

3/16/81

TITLE

DRAWING NO.


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Double Density Data Separator PCB-Schematic	200531F
2. Phase Locked FM Data Separator PCB-Assembly	200591J
Phase Locked FM Data Separator PCB-Schematic	200592D
3. Drive Electronics PCB-Assembly	200740E
Drive electronics PCB-Schematic	200741M (1 - 4)
4. Eject and Harness Board Side 1 PCB-Assembly	200746F
5. Eject and Harness Board Side 2 PCB-Assembly	200749F
6. Read/Write Module PCB-Assembly	200764D
Read/Write Module Schematic	200765C
Eject & Harness BD Side 1	200784D
Eject & Harness BD Side 2	200785D
7. Connection and Wiring Diagram Diskette Drive	200856E



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C	ECO	295	VE	11/78	11/7
D	ECO	302	VE	11/78	11/7
E	ECO	311	VE	11/78	11/7
F	SUFFIX	ECO 315 REWORK CHG	VE	11/78	11/7
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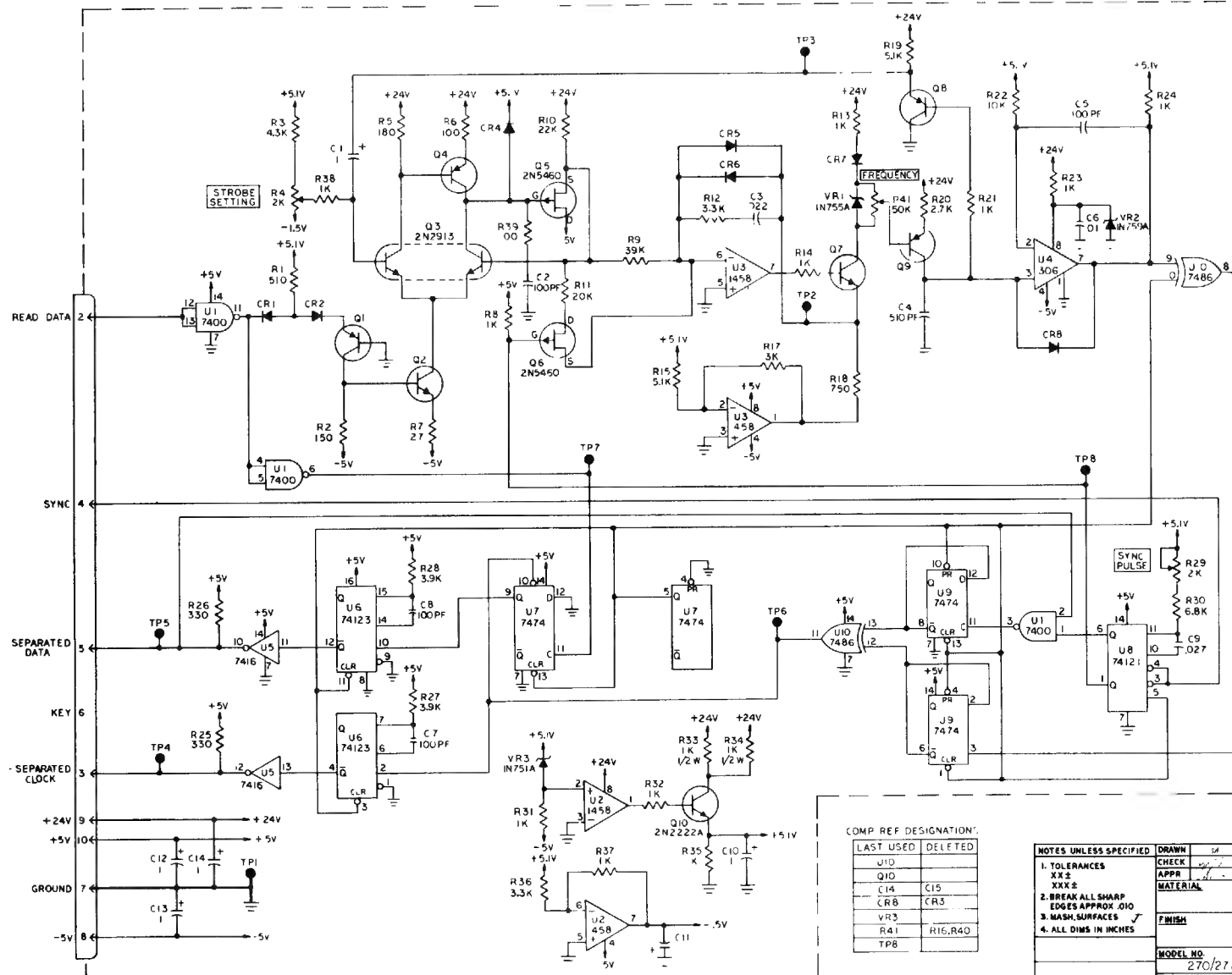
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 UNLESS OTHERWISE SPECIFIED;

PART NO TO BE 200530

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200530 J

M/L



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C	ECO 276		
D	ECO 303		
E	ECO 310		
F	ECO 318		

- 5 ALL PNP TRANSISTORS TO BE 2N4402.
 4 ALL NPN TRANSISTORS TO BE 2N4400
 3 ALL D ODES TO BE IN3064.
 2 ALL CAPACITORS IN MICROFARADS.
 1 ALL RESISTORS IN OHMS (1/4W, 5%
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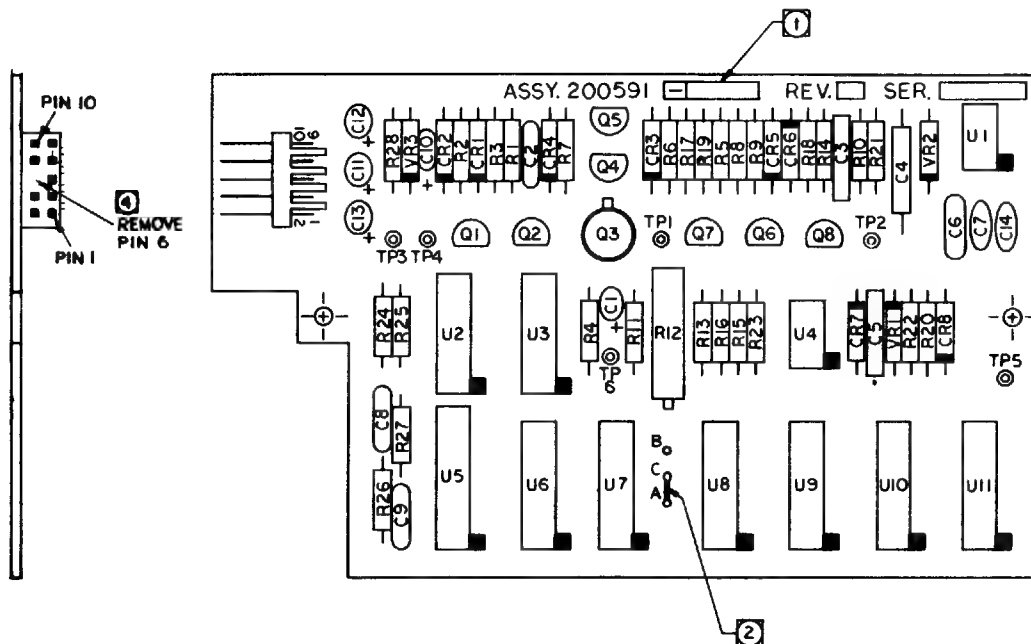
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Q10	
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CR8	CR3
VR3	
R41	R16, R40
TP8	

- NOTES UNLESS SPECIFIED:
 1. TOLERANCES
 XX%
 XXX%
 2. BREAK ALL SHARP
 EDGES APPROX .010
 3. MASH SURFACES
 4. ALL DIMS IN INCHES

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FINISH			
MODEL NO.	270/271/272		
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PerSci Incorporated		SCHMATIC.	DOUBLE DENSITY	DATA SEPARATOR	SHEET 1 OF 1
SCALE	C	SIZE	200531	F	
WEIGHT					



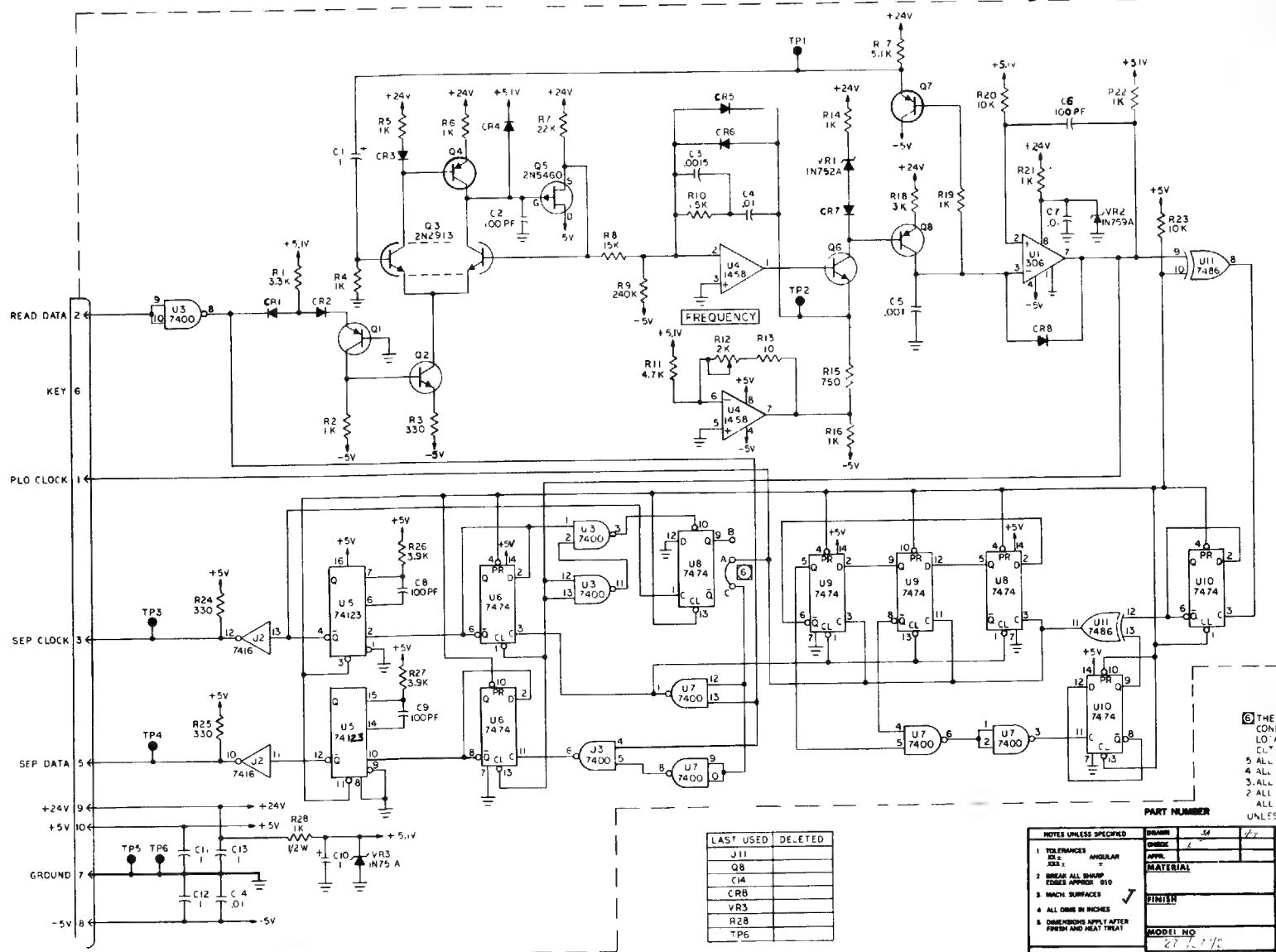
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E	ECO 378	WET	7/1/74
F	ECO 502	WET	7/1/74
G	ECO 597	WET	7/1/74
H	ECO 580	WET	7/1/74
I	ECO 576	WET	7/1/74

- ④ REMOVE KEYING PINS PRIOR TO INSTALLATION ON PCB.
 3. SCHEMATIC REF 200592.
 ② THE JUMPER BETWEEN A & C IS AN ETCHED CONDUCTOR. WHEN ANY OTHER JUMPER LOCATION IS REQUIRED- (SEE TABULATED M/L) CUT AWAY ETCH TRACE AND ADD JUMPER WIRE.
 ① MARK DASH VERSION, REVISION AND SERIAL NUMBER J2 HIGH BLACK CHARACTERS IN AREA SHOWN. UNLESS OTHERWISE SPECIFIED;

PART NO. TO BE 200591-XXX

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	WEIGHT		SHEET 1 OF 1	
	M/L			

200591 J



- ⑥ THE JUMPER BETWEEN A & C IS AN ETCHED CONDUCTOR WHEN ANY OTHER JUMPER LOCATION IS REQUIRED (SEE TABULARIAL M.A.)
 1. CLY. AWG. 18 TH. TRACE AND ADD JUMPER WIRE.
 2. ALL PNPN TRANSISTORS TO BE 2N4402.
 3. ALL DIODES TO BE IN3064.
 4. ALL CAPACITORS IN MICROFARADS.
 5. ALL RESISTORS IN OHMS 1/4W. 5% UNLESS OTHERWISE SPECIFIED.

LAST USED	DELETED
J11	
Q8	
C14	
CR8	
VR3	
R28	
TP6	

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PerSci Incorporated

SCHEMATIC
PHASE LOCKED FM
DATA SEPARATOR

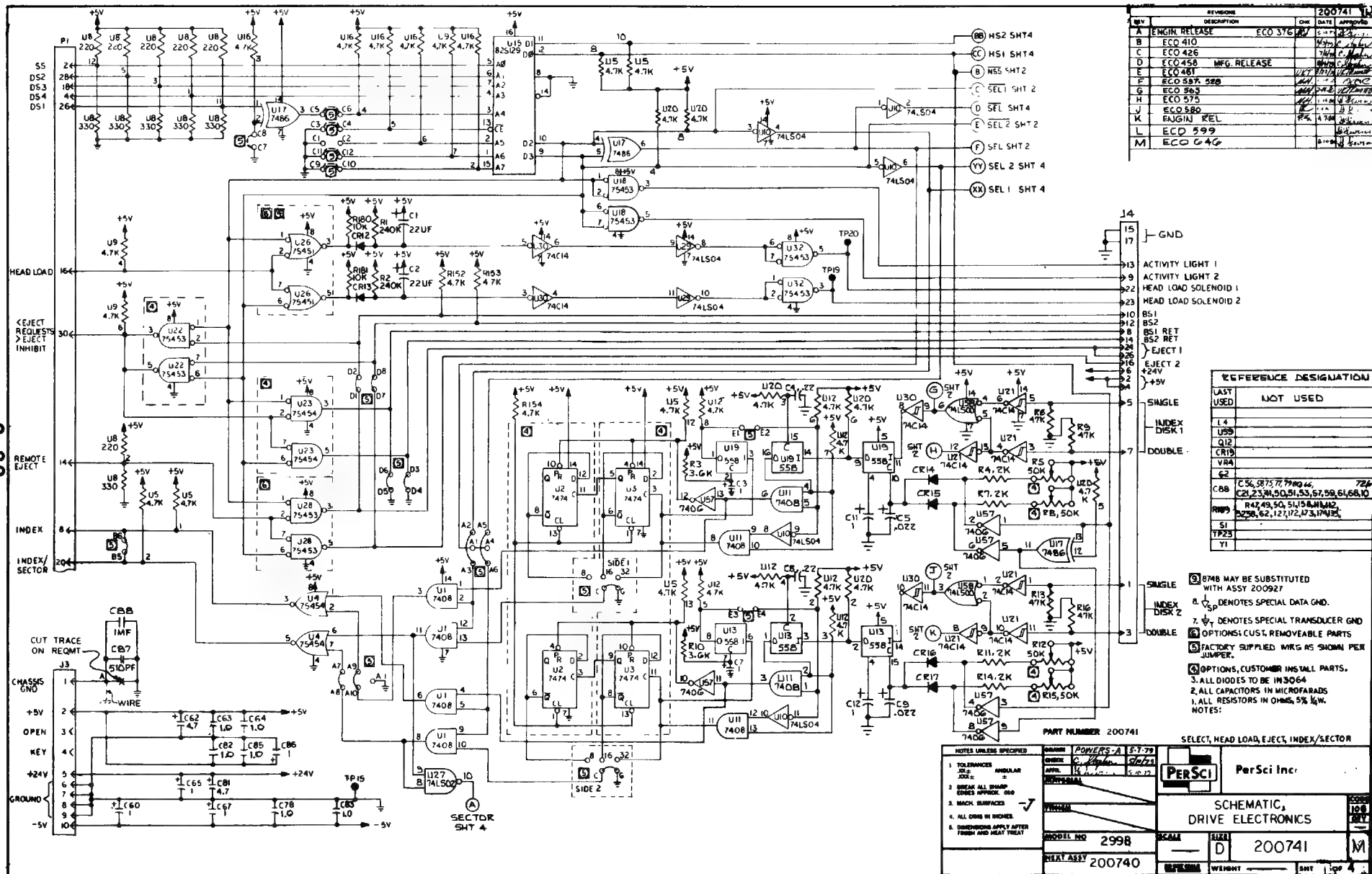
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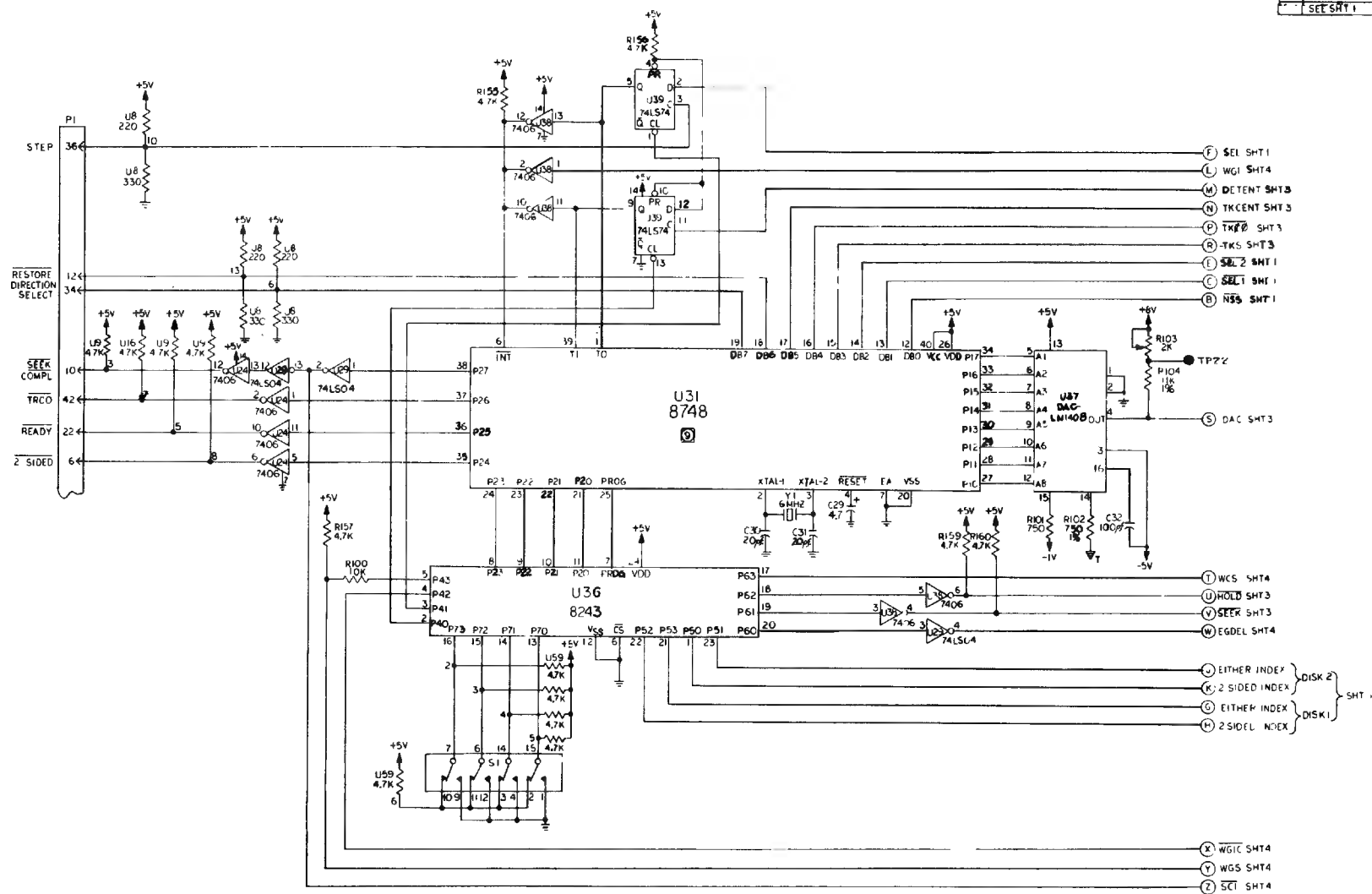
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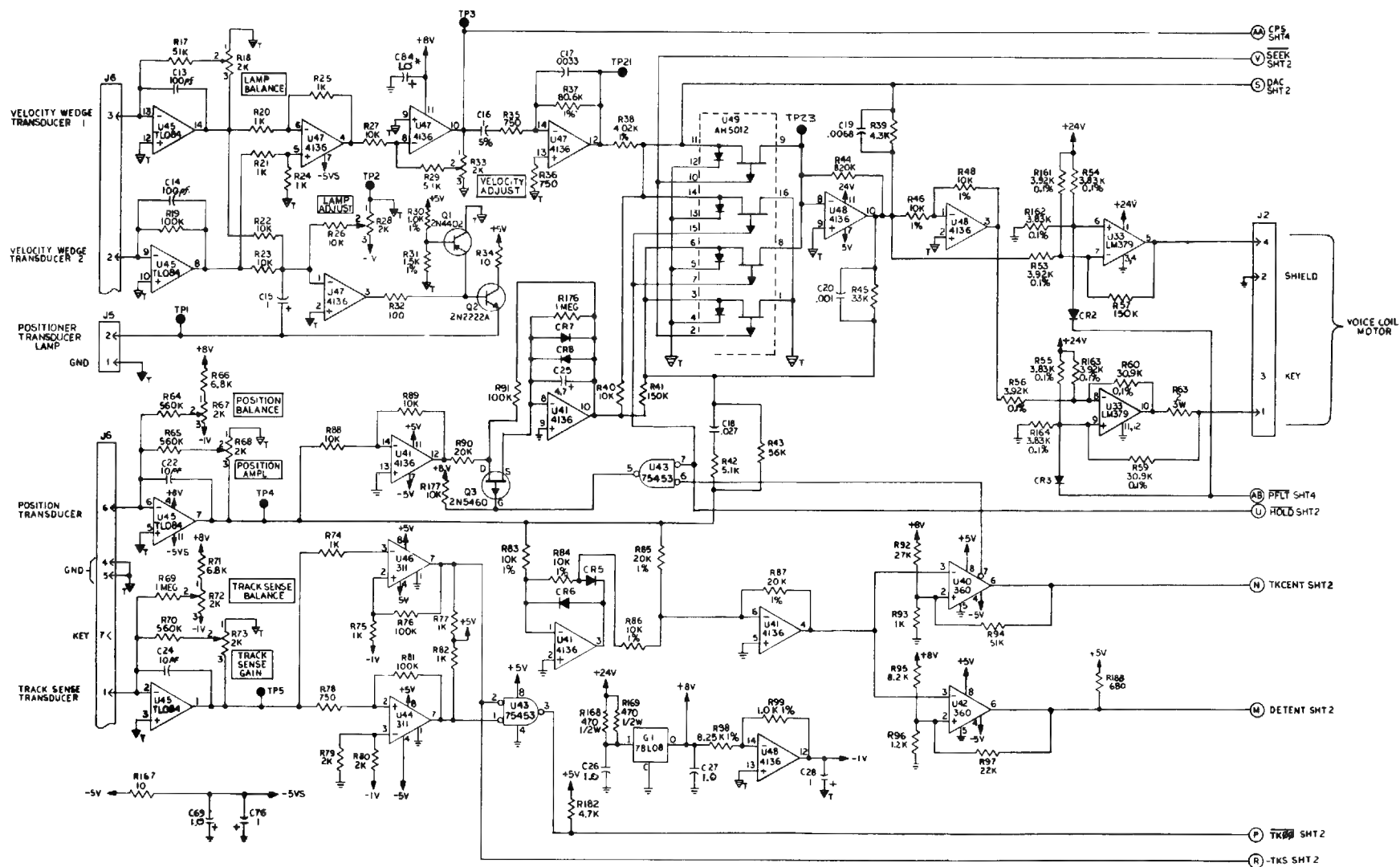
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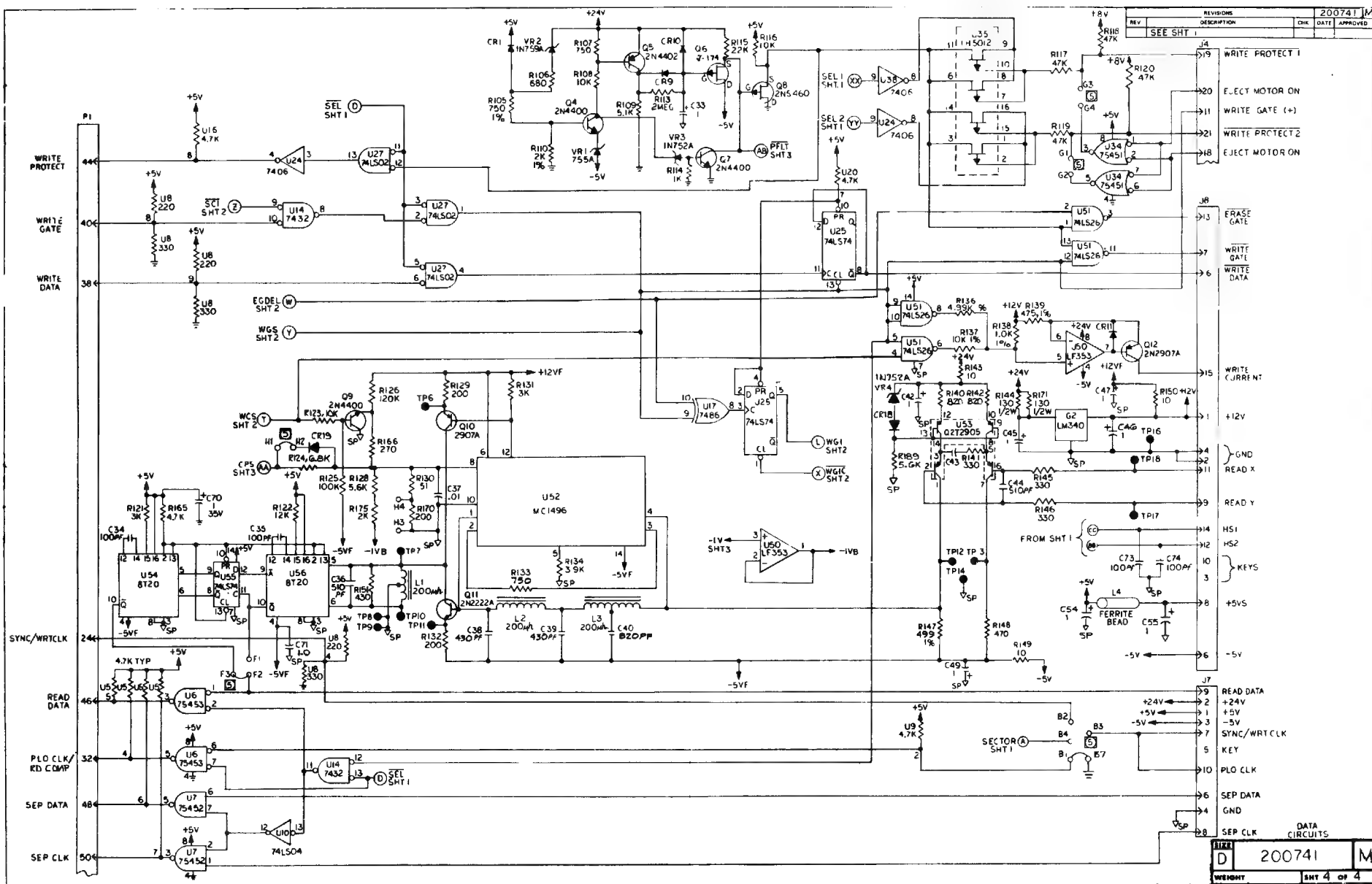
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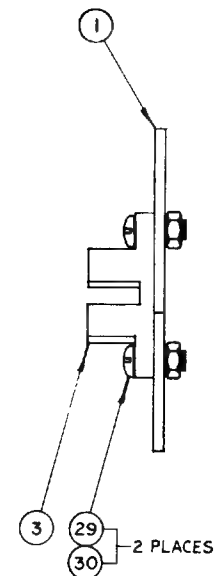
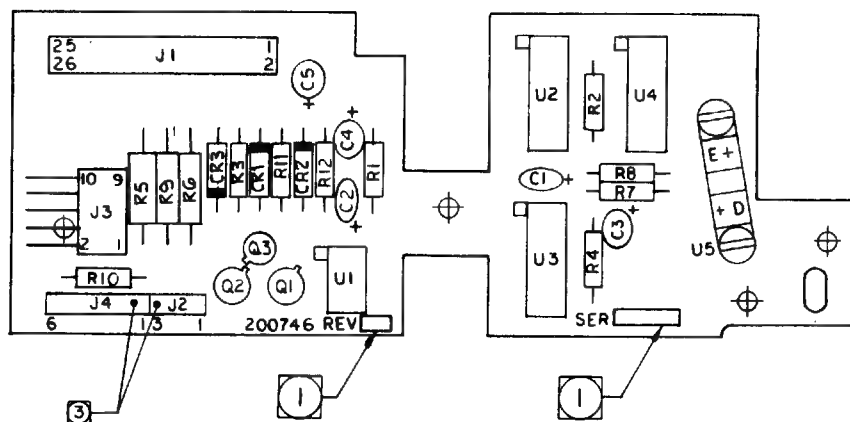
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PART NUMBER 200746

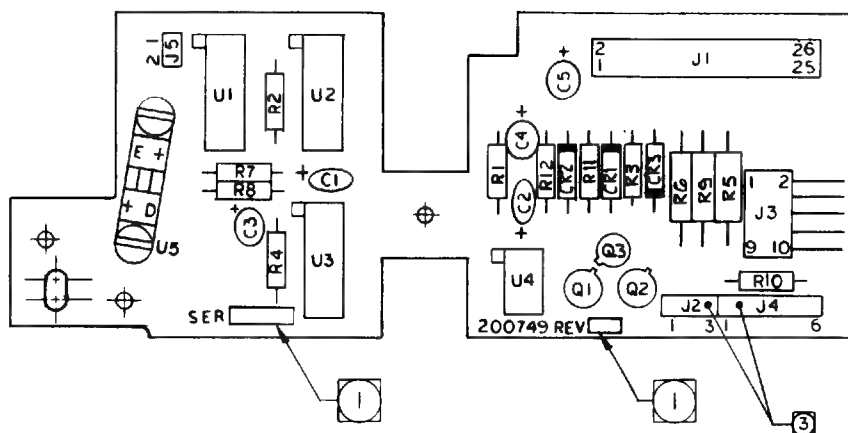
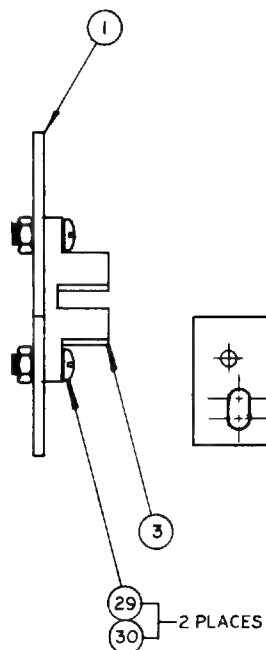
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- ① MARK DASH VERSIONS, REVISION AND SERIAL NUMBER .12 HIGH BLACK CHARACTERS IN AREA SHOWN.

UNLESS OTHERWISE SPECIFIED;

NOTES UNLESS SPECIFIED		DRAWN	POWERS-A	4-16-79		Per Sci Inc.
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200746 F



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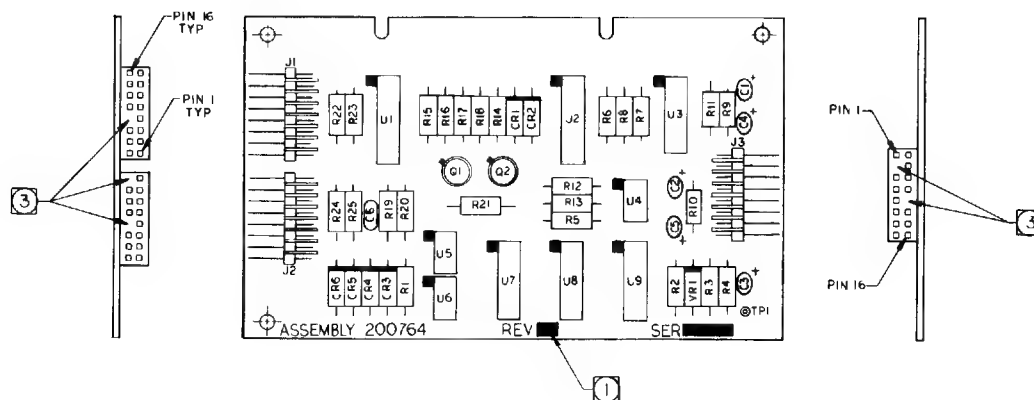
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200749 F

REVISIONS				200764	D
REV	DESCRIPTION	CHK	DATE	APPROVED	
A	ENG'N RELEASE DCR 24		7-77	BR	
B	SEE ECO 405				
C	SEE ECO 537				
D	SEE ECO 560				



CONNECTOR KEYING CHART	
CONNECTOR	REMOVE
J1	PIN 8
J2	PIN 8, 16
J3	PIN 3, 10

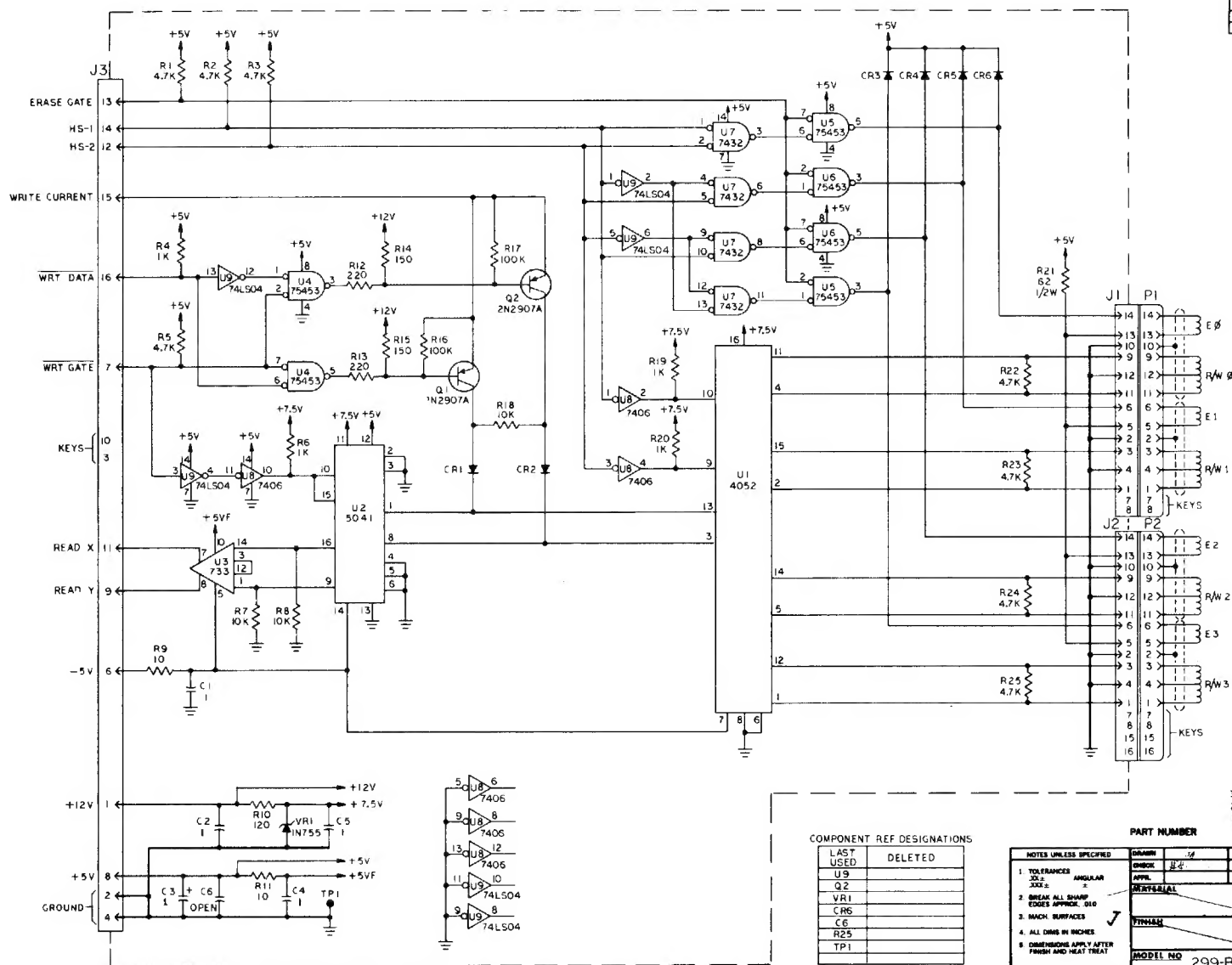
- 3 REMOVE CONNECTOR PINS AS SPECIFIED IN CONNECTOR KEYING CHART PRIOR TO CONNECTOR INSTALLATION.
- 2 SCHEMATIC REF 200765.
- 1 MARK REVISION AND SERIAL NUMBERS .12 HIGH BLACK CHARACTERS IN AREA SHOWN UNLESS OTHERWISE SPECIFIED:

PART NUMBER 200764

NOTES UNLESS SPECIFIED		DRUM	POWERS-A	2/22/79
1 TOLERANCES X.25 X.125 X.0625	ANGULAR °	CHICK		
2 BREAK ALL SHARP EDGES APPROX. 0.10		APPL		
3 MACH SURFACES		MATERIAL		
4 ALL DIMS IN INCHES		FINISH		
5 DIMENSIONS APPLY AFTER FINISH AND HEAT TREAT		MODEL NO	299B	SCALE 2:1
		NEXT ASSY	200800	SHEET 1 OF 1

PERSCI		PerSci Incorporated	
ASSEMBLY, PCB		READ/WRITE MODULE	
SIZE D		200764	
WEIGHT		D	

200764 D



REV	DESCRIPTION	CHK	DATE	APPROVED
A	ENGINE RELEASE DCR 24	PS	11/1/79	PS
B	ECO 527	PS	11/1/79	PS
C	ECO 580	PS	11/1/79	PS

3. ALL DIODES TO BE 1N3064.
 2. ALL CAPACITOR VALUES IN MICROFARADS.
 1. ALL RESISTOR VALUES IN OHMS 1/4W 5%.

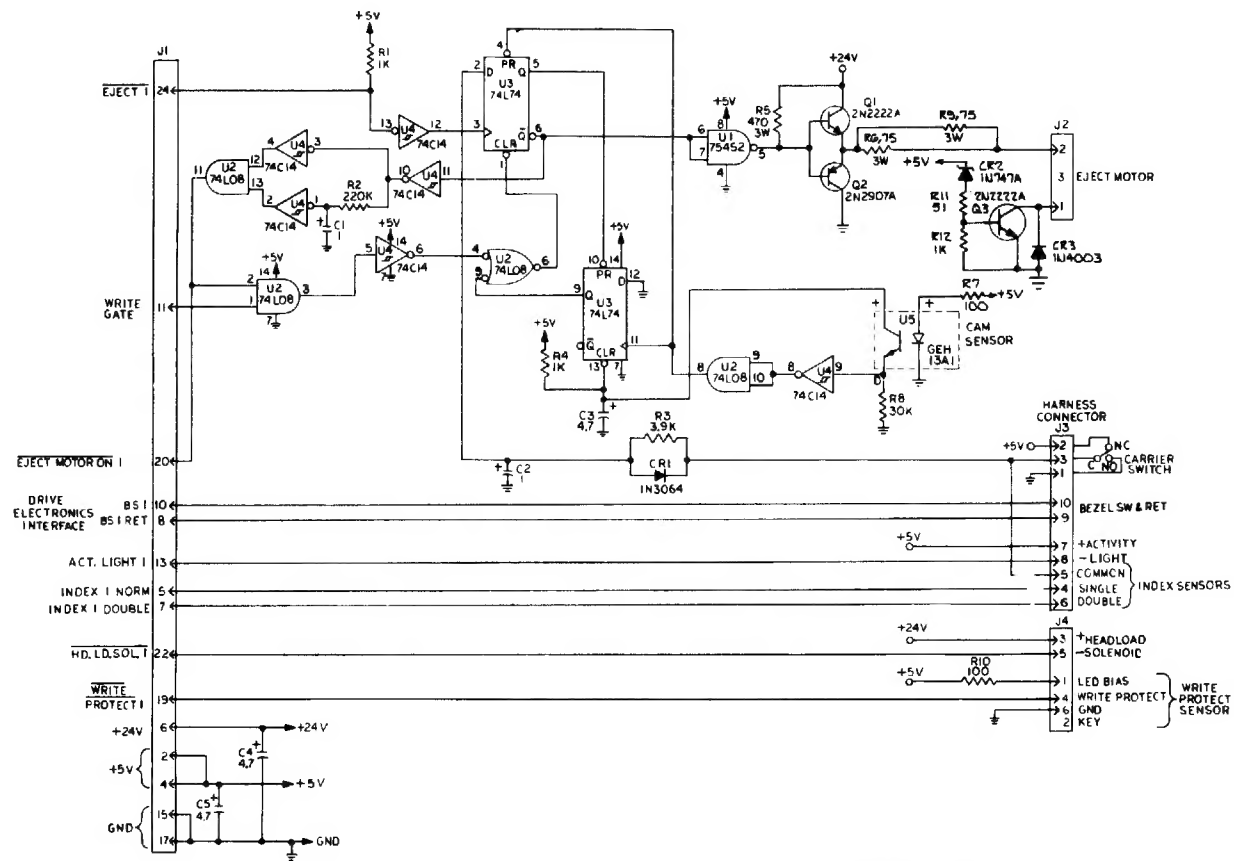
NOTES: UNLESS OTHERWISE SPECIFIED:

COMPONENT REF DESIGNATIONS

LAST USED	DELETED
U9	
Q2	
VR1	
CR6	
C6	
R25	
TP1	

PART NUMBER

NOTES UNLESS SPECIFIED	DESIGN	DATE	REV
1. TOLERANCES UNLESS SPECIFIED RESISTORS ANGULAR DIMENSIONS 2. BREAK ALL SHARP EDGES APPROX. 0.10 3. MACH. SURFACES 4. ALL DIMS IN INCHES 5. DIMENSIONS APPLY AFTER FINISH AND HEAT TREAT	CHKD #4	11/1/79	1
<div style="display: flex; justify-content: space-between;"> <div> <p>PerSci Incorporated</p> <p>SCHMATIC, PCB.</p> <p>READ WRITE ERASE MODULE</p> </div> <div> <p>CODE 108</p> <p>SIT</p> </div> </div>			
MODEL NO	299-B	SCALE	D
NEXT ASSY	200764	WEIGHT	200765
		SHT	1 OF 1



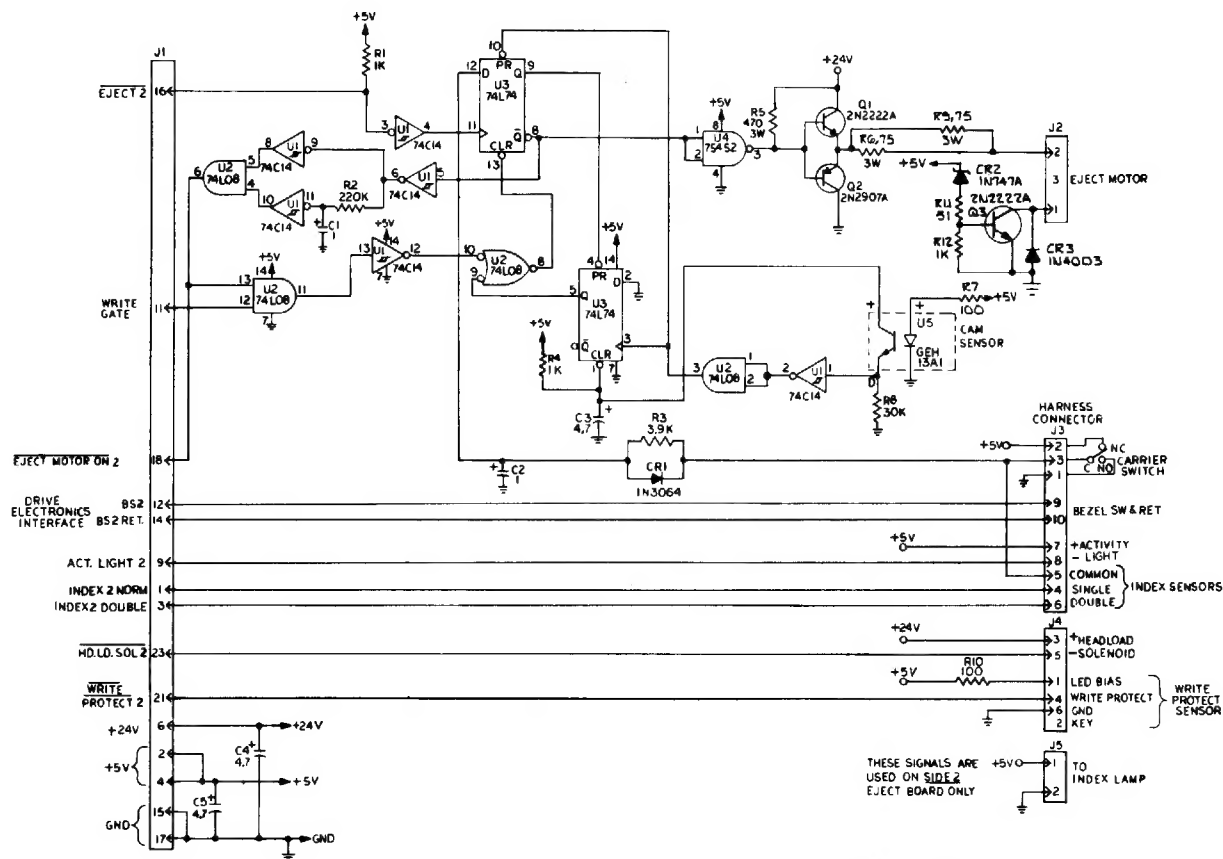
LAST USED	DELETED
U5	
Q3	
CR3	
C5	
R2	
J4	

2. CAPACITORS IN MICROFARADS.
 1. RESISTORS IN OHMS, 1/4W, 5%.
 NOTES: UNLESS OTHERWISE SPECIFIED.

REV	DESCRIPTION	CHK	DATE	APPROVED
A	ENG. REL. SEE ECO 387	P	3/84	1/1/84
B	ECO 412			
C	ECO 515	UC	1/1/84	1/1/84
D	ECO 529	ALV	1/1/84	1/1/84

PART NUMBER

NOTES UNLESS SPECIFIED		DRAWN POWERS-A 39-79		CHECKED V 52-79		PERSCI		PerSci Incorporated	
1. TOLERANCES UNLESS SPECIFIED		APPROVAL		APPROVAL		APPROVAL		APPROVAL	
2. BREAK ALL SHARP EDGES APPROX. .010		3. MACH. SURFACES		4. ALL DIMS IN INCHES		5. DIMENSIONS APPLY AFTER FINISH AND HEAT TREAT		SCHEMATIC PCB EJECT & HARNESS BD SIDE 1	
MODEL NO 2998		SCALE NONE		SIZE D		200784		D	
NEXT ASSY 200746		SUPPLIER		WEIGHT		SMT		OF	



THESE SIGNALS ARE
USED ON SIDE 2
EJECT BOARD ONLY

LAST USED	DELETED
U5	
Q3	
CR3	
C5	
R12	
U5	

2. CAPACITOR IN MICROFARADS.
1. RESISTORS IN OHMS, 1/4W, 5%
NOTES: UNLESS OTHERWISE SPECIFIED.

PART NUMBER

NOTES UNLESS SPECIFIED		DRAWING NO. POWERS-A 3879		REV. 1	
1. TOLERANCES UNLESS SPECIFIED: RESISTORS: 1% CAPACITORS: 5%		APPROVED: [Signature]		DATE: 11/17/78	
2. BREAK ALL SWAMP EDGES APPROX. .010		DESIGNED: [Signature]		CHECKED: [Signature]	
3. MACH. SURFACES ALL DIMS IN INCHES		FURNISH:		SCALE: NONE	
4. ALL DIMS IN INCHES		MODEL NO. 2998		SHEET: 1 OF 1	
5. DIMENSIONS APPLY AFTER FINISH AND HEAT TREAT		NEXT ASSY: 200749		WEIGHT: 1.00	
		PERSCI		PerSci Incorporated	
		SCHEMATIC EJECT & HARNESS BD SIDE 2		CODE: 100 977	

REV.	DESCRIPTION	CHK.	DATE	APPROVED
A	ENG. REL. - SEE ECO 388		11/17/78	
B	ECO 412		11/17/78	
C	ECO 515		11/17/78	
D	ECO 529		11/17/78	

The diagram illustrates the electrical connections for the PerSci 100013 system. Key components and their connections include:

- Mask Assembly (200843):** Connected to VEL WEDGE XDCUER 1, VEL WEDGE XDCUER 2, F. POSITIONER XDCUER 1, TRACK SENSE XDCUER 1, and GND 1.
- Positioner Lamp (200617-001):** Connected to BLK P, POSITIONER LAMP GRD, and 2 FINISH.
- Positioner Motor (200023):** Connected to RED/BLK, GRM/WHT, and 1 START.
- Drive Electronics Board (200740):** Central board with multiple connectors (P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22, P23, P24, P25, P26, P27, P28, P29, P30, P31, P32, P33, P34, P35, P36, P37, P38, P39, P40, P41, P42, P43, P44, P45, P46, P47, P48, P49, P50, P51, P52, P53, P54, P55, P56, P57, P58, P59, P60, P61, P62, P63, P64, P65, P66, P67, P68, P69, P70, P71, P72, P73, P74, P75, P76, P77, P78, P79, P80, P81, P82, P83, P84, P85, P86, P87, P88, P89, P90, P91, P92, P93, P94, P95, P96, P97, P98, P99, P100, P101, P102, P103, P104, P105, P106, P107, P108, P109, P110, P111, P112, P113, P114, P115, P116, P117, P118, P119, P120, P121, P122, P123, P124, P125, P126, P127, P128, P129, P130, P131, P132, P133, P134, P135, P136, P137, P138, P139, P140, P141, P142, P143, P144, P145, P146, P147, P148, P149, P150, P151, P152, P153, P154, P155, P156, P157, P158, P159, P160, P161, P162, P163, P164, P165, P166, P167, P168, P169, P170, P171, P172, P173, P174, P175, P176, P177, P178, P179, P180, P181, P182, P183, P184, P185, P186, P187, P188, P189, P190, P191, P192, P193, P194, P195, P196, P197, P198, P199, P200, P201, P202, P203, P204, P205, P206, P207, P208, P209, P210, P211, P212, P213, P214, P215, P216, P217, P218, P219, P220, P221, P222, P223, P224, P225, P226, P227, P228, P229, P230, P231, P232, P233, P234, P235, P236, P237, P238, P239, P240, P241, P242, P243, P244, P245, P246, P247, P248, P249, P250, P251, P252, P253, P254, P255, P256, P257, P258, P259, P260, P261, P262, P263, P264, P265, P266, P267, P268, P269, P270, P271, P272, P273, P274, P275, P276, P277, P278, P279, P280, P281, P282, P283, P284, P285, P286, P287, P288, P289, P290, P291, P292, P293, P294, P295, P296, P297, P298, P299, P300, P301, P302, P303, P304, P305, P306, P307, P308, P309, P310, P311, P312, P313, P314, P315, P316, P317, P318, P319, P320, P321, P322, P323, P324, P325, P326, P327, P328, P329, P330, P331, P332, P333, P334, P335, P336, P337, P338, P339, P340, P341, P342, P343, P344, P345, P346, P347, P348, P349, P350, P351, P352, P353, P354, P355, P356, P357, P358, P359, P360, P361, P362, P363, P364, P365, P366, P367, P368, P369, P370, P371, P372, P373, P374, P375, P376, P377, P378, P379, P380, P381, P382, P383, P384, P385, P386, P387, P388, P389, P390, P391, P392, P393, P394, P395, P396, P397, P398, P399, P400, P401, P402, P403, P404, P405, P406, P407, P408, P409, P410, P411, P412, P413, P414, P415, P416, P417, P418, P419, P420, P421, P422, P423, P424, P425, P426, P427, P428, P429, P430, P431, P432, P433, P434, P435, P436, P437, P438, P439, P440, P441, P442, P443, P444, P445, P446, P447, P448, P449, P450, P451, P452, P453, P454, P455, P456, P457, P458, P459, P460, P461, P462, P463, P464, P465, P466, P467, P468, P469, P470, P471, P472, P473, P474, P475, P476, P477, P478, P479, P480, P481, P482, P483, P484, P485, P486, P487, P488, P489, P490, P491, P492, P493, P494, P495, P496, P497, P498, P499, P500, P501, P502, P503, P504, P505, P506, P507, P508, P509, P510, P511, P512, P513, P514, P515, P516, P517, P518, P519, P520, P521, P522, P523, P524, P525, P526, P527, P528, P529, P530, P531, P532, P533, P534, P535, P536, P537, P538, P539, P540, P541, P542, P543, P544, P545, P546, P547, P548, P549, P550, P551, P552, P553, P554, P555, P556, P557, P558, P559, P560, P561, P562, P563, P564, P565, P566, P567, P568, P569, P570, P571, P572, P573, P574, P575, P576, P577, P578, P579, P580, P581, P582, P583, P584, P585, P586, P587, P588, P589, P590, P591, P592, P593, P594, P595, P596, P597, P598, P599, P600, P601, P602, P603, P604, P605, P606, P607, P608, P609, P610, P611, P612, P613, P614, P615, P616, P617, P618, P619, P620, P621, P622, P623, P624, P625, P626, P627, P628, P629, P630, P631, P632, P633, P634, P635, P636, P637, P638, P639, P640, P641, P642, P643, P644, P645, P646, P647, P648, P649, P650, P651, P652, P653, P654, P655, P656, P657, P658, P659, P660, P661, P662, P663, P664, P665, P666, P667, P668, P669, P670, P671, P672, P673, P674, P675, P676, P677, P678, P679, P680, P681, P682, P683, P684, P685, P686, P687, P688, P689, P690, P691, P692, P693, P694, P695, P696, P697, P698, P699, P700, P701, P702, P703, P704, P705, P706, P707, P708, P709, P710, P711, P712, P713, P714, P715, P716, P717, P718, P719, P720, P721, P722, P723, P724, P725, P726, P727, P728, P729, P730, P731, P732, P733, P734, P735, P736, P737, P738, P739, P740, P741, P742, P743, P744, P745, P746, P747, P748, P749, P750, P751, P752, P753, P754, P755, P756, P757, P758, P759, P760, P761, P762, P763, P764, P765, P766, P767, P768, P769, P770, P771, P772, P773, P774, P775, P776, P777, P778, P7

NAME	P. ANDERSON	6-18-79		PerSci Inc.
DATE	<i>10/2/80</i>	10-2-80		
TIME	11:45 AM	10-2-80	PERSCI	
MATERIAL				
FINISH			CONNECTION & WIRING DIAGRAM	
			DISKETTE DRIVE	
MODEL NO	299B	SCALE	1:1	200856
SERIAL	200800	NONE		E
		WEIGHT	ENT	OF